Exhibit 1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Anton Monk et al.		
U.S. Patent No.:	7,295,518	Attorney Docket No.:	45035-0025IP1
Issue Date:	November 13, 2007		
Appl. Serial No.:	10/322,834		
Filing Date:	December 18, 2002		
Title:	BROADBAND NETWORK FOR COAXIAL CABLE USING MULTI-CARRIER MODULATION		

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 7,295,518 PURSUANT TO 35 U.S.C. §§311–319, 37 C.F.R. §42

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DISH-1017	Excerpts from Robert M. Gagliardi, *Introduction to Communications Engineering*, 2d ed., 1988 ("Gagliardi")
DISH-1018	U.S. Patent No. 5,822,372 to Emami ("Emami")
DISH-1019	Excerpts from Shlomo Ovadia, *Broadband Cable TV Access Networks*, 1d ed., March 2001 ("Ovadia")
DISH-1020	U.S. Patent No. 5,488,632 to Mason et al. ("Mason")
DISH-1021	Excerpts from Walter Y. Chen, *DSL: Simulation Techniques and Standards Development for Digital Subscriber Lines*, 1998 ("DSL Simulation Techniques")
DISH-1022	Excerpts from Dennis J. Rauschmayer, *ADSL/VDSL Principles*, 1999 ("ADSL/VDSL Principles")
DISH-1023	Jacobsen, Krista S., *Synchronized Discrete Multi-Tone (SDMT) Modulation for Cable Modems: Making the Most of the Scarce Reverse Channel Bandwidth*, WESCON/97 Conference Proceedings, Santa Clara, CA, USA, 1997 ("Jacobsen2")
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LISTING OF CHALLENGED CLAIMS

Claim Language	
Claim 1	
[1pre]	A data communication network comprising:
[1a.i]	at least two network devices,
[1a.ii]	each network device comprising a multi-carrier modulator for modulating data, an up converter for translating the modulated data to an RF carrier frequency, a down converter for translating an RF signal, and a multi-carrier demodulator for demodulating the translated RF signal to produce data; and
[1b]	cable wiring comprising a splitter with a common port and a plurality of tap ports, and a plurality of segments of coaxial cable connecting between the splitter tap ports and the network devices;
[1c]	whereby network devices communicate with each other through the cable wiring using multi-carrier signaling;
[1d.i]	wherein network devices transmit probe messages through the cable wiring and analyze received probe message signals to determine channel characteristics and
[1d.ii]	bit loading is selected based on the determined channel characteristics.

Claim Language	
Claim 3	
[3a]	The data communication network of claim 1 wherein the network shares the cable wiring with a cable television service
[3b]	and the network device up converter translates the modulated data to an RF carrier frequency above the frequency used by the cable television service.

I. INTRODUCTION

DISH Network L.L.C., Dish Network Service L.L.C., DISH Network Corporation, and Dish Network California Service Corporation, (collectively, "Petitioner" or "DISH") petition for *Inter Partes* Review ("IPR") under 35 U.S.C. §§311–319 and 37 C.F.R. §42 of claims 1, 3 ("the Challenged Claims") of U.S. Patent No. 7,295,518 ("'518 patent").

The '518 patent relates to a local area network (LAN) implemented on the coaxial cables of a cable television (CATV) network. The '518 patent admits that coaxial-based networks were known when the patent was filed. The '518 patent purports to allow a LAN to share a coaxial network with CATV by using communication techniques, like multi-carrier signaling, bit-loading, and channel probing, that—by the '518 patent's own admission—were well-known before the patent was filed. The '518 patent's claims, which initially only recited multi-carrier signaling (and other well-known network components like RF converters), were only allowed after Applicant amended the claims to add the bit-loading and channel probing limitation.

The asserted references, in combination, render obvious the '518 patent's claimed invention including the claimed communication techniques. Specifically, (i) Kliger and Amit both teach a LAN implemented on coaxial cables of a CATV network, (ii) Kliger, Jacobsen, and Isaksson teach multi-carrier signaling,

(iii) Jacobsen and Isaksson teach bit-loading, and (iv) Isaksson teaches selecting bit-loading based on channel characteristics determined using channel probing.

The ’518 patent’s claims represent nothing more than the predictable results obtained by combining prior art elements according to known techniques (*i.e.*, implementing a LAN with multi-carrier signaling, bit-loading, and channel probing on a CATV network’s coaxial cables). Petitioner requests that the Board enter a final written decision finding that the Challenged Claims are not patentable.

II. REQUIREMENTS FOR IPR—37 C.F.R. §42.104

A. Grounds for Standing—37 C.F.R. §42.104(a)

Petitioner certifies that the ’518 patent is available for IPR and Petitioner is not barred or estopped from requesting this review. The present Petition is filed within one year of service of a complaint against DISH in the U.S. District Court for the Central District of California (“District Court”), 2:23-CV-01043 (C.D. Cal.). *See* DISH-1025; DISH-1028.

B. Challenge and Relief Requested—37 C.F.R. §42.104(b)

This Petition demonstrates a reasonable likelihood of prevailing as to at least one Challenged Claim. Petitioner requests institution of IPR and cancellation of all Challenged Claims on the grounds identified below. The expert declaration (DISH-1004) of Tim A. Williams, Ph.D. provides complementary explanation and support for each ground.

Ground	Claims	§103 Basis
1	1, 3	Kliger in view of Isaksson
2	1, 3	Amit in view of Jacobsen and Isaksson

Each reference pre-dates 2001-08-30 ("Critical Date"), which is the earliest possible date from which the '518 patent can claim priority.[1]

Reference	Prior Art Date (at least as early as)[2]	Basis (at least under)
Kliger (DISH-1007)	2001-06-11 (filing date of priority provisional application)	§102(e)
Isaksson (DISH-1013)	1998-03-12 (publication date)	§102(b)
Amit (DISH-1014)	2000-04-12 (filing date)	§102(e)
Jacobsen (DISH-1016)	1995-09-19 (publication date)	§102(b)

C. Claim Construction—37 C.F.R. §42.104(b)(3)

Because the Challenged Claims are obvious under any reasonable interpretation, no express constructions are required in this proceeding. *See Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011) ("claim terms need only be construed to resolve a controversy"). DISH reserves the right to address any construction the Patent Owner or Board proposes. DISH

[1] Petitioner does not concede that the '518 patent is entitled to the claimed priority.

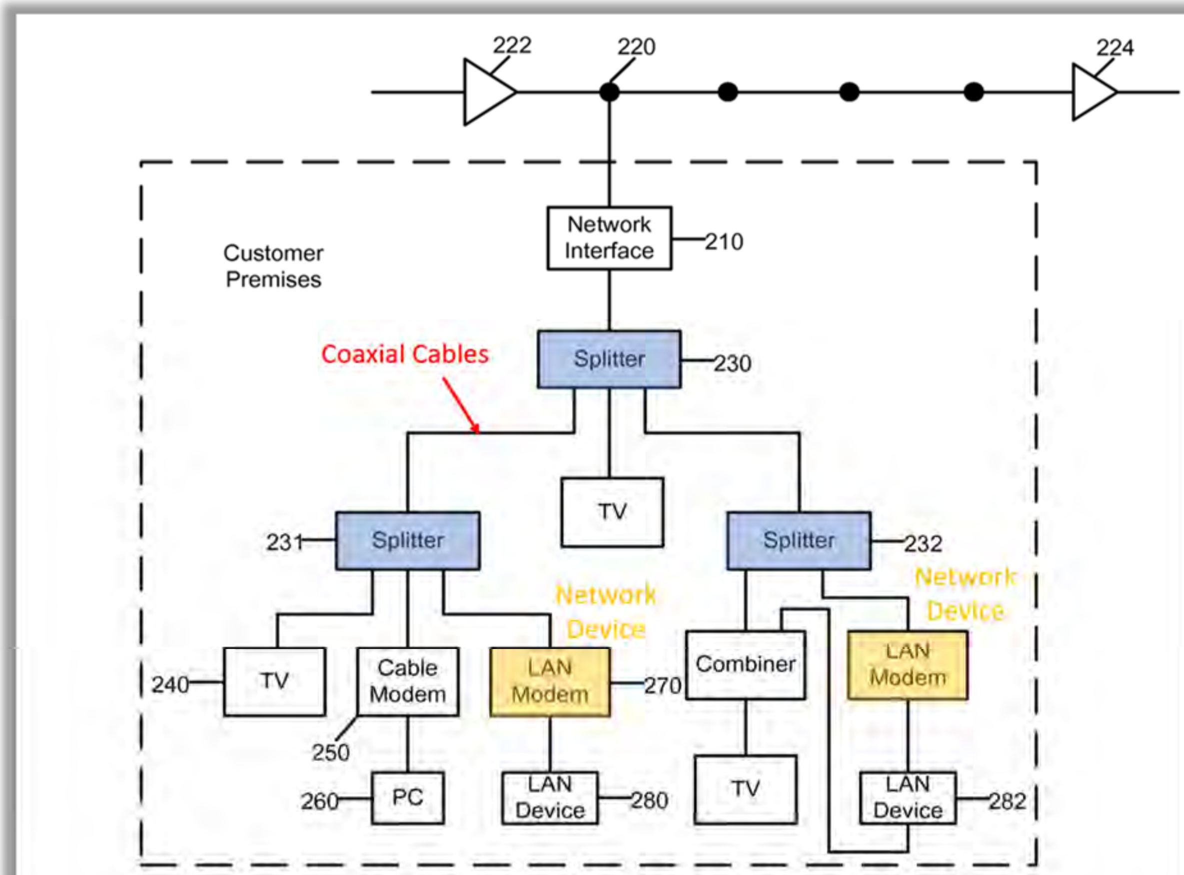
[2] *See* §§IV.A.1-2, IV.B.1-2 for explanations of these dates.

also reserves the right to pursue constructions in district court that are necessary to decide matters of infringement and validity under §112 that exceed the scope of IPR. *See* 35 U.S.C. §311(b). DISH does not concede that the Challenged Claims satisfy statutory requirements, including §112.

III. THE ’518 PATENT

A. Summary

The ’518 patent is directed to “communications using coaxial cable building wiring.” DISH-1001, 1:27-29. The ’518 patent describes “a coaxial cable based local area network (LAN)” that shares cables with a CATV network. *Id.*, 1:33-36. Figure 2 illustrates a LAN implemented on a CATV infrastructure. *Id.*, Fig. 2, 5:35-40; DISH-1004, ¶¶26-31.



'518 PATENT FIG. 2 (Annotated)

As shown in Figure 2, the CATV infrastructure includes coaxial cables (red) and splitters (blue). The splitters "distribute downstream signals from the point of entry (POE) to the various terminals in the home." DISH-1001, 1:33-45. These splitters have an "input port [that] can also be considered a common port" and "output ports [that] can also be considered tap ports." *Id.*, 1:54-57; DISH-1004, ¶¶26-32.

The '518 patent implements the LAN by incorporating into the CATV infrastructure network devices (orange) that employ the techniques of multi-carrier

modulation and bit-loading. *See* DISH-1001, 4:35-47, Fig. 2, 8:1-3. As admitted by the ’518 patent, both techniques were known before the Critical Date. *See id.*, 8:19-26 (“U.S. Pat. No. 6,438,174 … discloses discrete multi-tone modulation and a technique for bit loading … [and] U.S. Pat. No. 6,259,746 … discloses a technique for bit loading applied to discrete multi-tone modulation.”); *see also* 3:52-4:18. The ’518 patent, which also refers to multi-carrier modulation as multi-tone modulation, lists discrete multi-tone (DMT) and orthogonal frequency division multiplexing (OFDM) as multi-carrier modulation techniques. *See id.*, 7:22-27; DISH-1004, ¶¶32-33.

“Multi-tone modulation uses a set of modulating carriers” for carrying data bits. DISH-1001, 7:22-24. For example, “OFDM utilizes quadrature phase shift keying (QPSK) and multi-level quadrature amplitude modulation (QAM) wherein each OFDM carrier can be modulated by an amplitude/phase-varying signal.” *Id.*, 7:27-30. To perform the modulation, “data bits are encoded into a number of … QAM constellations, which then modulate the respective carriers.” *Id.*, 7:35-38. The modulated carriers are summed together for transmission over a channel. *Id.*, 7:38-40; DISH-1004, ¶34.

The number of QAM constellations refers to the number of unique amplitude/phase combinations that are available for a particular carrier. *Id.*, ¶35. The number of combinations in turn specifies the number of data bits that can be

modulated onto the carrier. *Id.*

Bit-loading "allocate[es] a higher order signal constellation to carriers that have higher signal to noise ratio and a lower order constellation to carriers that have lower signal to noise ratio." DISH-1001, 8:9-12. That is, bit-loading allocates more bits to carriers that have higher SNR and fewer bits to carriers with lower SNR. DISH-1004, ¶36. To estimate channel characteristics, including SNR, "[c]hannel probing messages are transmitted between network devices" (DISH-1001, 9:35-37), where a "channel probe uses a predetermined bit sequence which in [sic] known by the receiving device" (*id.*, 9:37-41). The '518 patent admits that "[d]etermination of a … SNR profile from a known signal is well known in the art." *Id.*, 10:12-16; DISH-1004, ¶¶37-39.

B. Applicant Admitted Prior Art (AAPA)

Throughout the '518 patent, Applicant described the state of the art by referencing and incorporating nearly 20 prior art references. The AAPA establishes that the '518 patent claims conventional components and functionality. The chart below provides a summary of the claimed concepts that Applicant admitted as being in the prior art. Dr. Williams provides a more detailed analysis in his declaration. DISH-1004, ¶¶40-44.

Claimed Concept	Applicant's Admission
Multi-carrier modulation	DISH-1001, 3:56-4:18, 9:29-32
Bit-loading	DISH-1001, 8:9-26

Claimed Concept	Applicant's Admission
RF-conversion circuitry	DISH-1001, 4:8-19
Probe messaging for channel characterization	DISH-1001, 10:21-28

C. The '518 Patent is not Entitled to the Benefit of Any Filing Date Before March 2002

The cover of the '518 patent states it is a continuation of the '687 parent application. As explained below, U.S. Patent Appl. No. 10/322,834 ("'834 application), which issued as the '518 patent, cannot claim priority to the '687 parent application due to the lack of copendency between the two applications. Therefore, the '834 application is not entitled to the benefit of the '687 parent application's earlier filing date.

Further, whether the '518 patent is entitled to the benefit of the filing date of any of the provisional applications listed on the patent's cover must be assessed independently. Because the '834 application was filed more than twelve months after the 2001-08-30 filing date of U.S. Provisional Appl. No. 60/316,820 ("'820 provisional"), it is not entitled to claim priority to the '820 provisional. Rather, the earliest possible date to which the '518 patent may claim priority is 2002-03-12 based on U.S. Provisional Appl. No. 60/363,420 ("'420 provisional").[3]

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[3] Petitioner does not concede that this is the effective priority date of the '518 patent.

1. The ’834 application and the ’687 parent application were never copending

To establish a nonprovisional application’s claim to the filing date of an earlier nonprovisional application, the two applications must be copending. 37 CFR §1.78 (“A nonprovisional application may claim an invention disclosed in one or more prior filed ***copending nonprovisional applications***.”); MPEP §201.11 (“With respect to claiming benefit under 35 U.S.C. 120 … ***the second application must be copending with the first application***.”).[4,5] MPEP §201.11 explains that “[i]f the first application is abandoned, the second application ***must be filed before the abandonment*** in order for it to be copending with the first.”

As explained below, the ’687 parent application was abandoned before the ’834 application was filed. So, the two applications were never copending.

The ’687 parent application was filed 2002-08-29. DISH-1003, 1.[6] On 2002-10-01, the USPTO mailed a notice of missing parts (“Missing-Parts-Notice”) setting a reply period that expired on 2002-12-02. *Id.*, 37. Applicant never responded to the Missing-Parts-Notice—no reply, petition, or fee for extension of time was ever filed. *Id.*, 39, 41. Because Applicant never responded to the Missing-Parts-Notice in the ’687 parent application, that application was

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[4] All emphasis added unless otherwise stated.
[5] Citations to MPEP’s 8th-edition published 2001-08.
[6] Citations to stamped page numbers.

considered abandoned when the reply period expired on 2002-12-02. DISH-1003, 39; 35 U.S.C. §133; MPEP §711.04(a) ("…the date of the abandonment is after midnight of the date the period for reply actually expired.").

Instead of responding to the Missing-Parts-Notice, Applicant filed the '834 application on 2002-12-18 accompanied by an express abandonment (Abandonment Request) of the '687 parent application. DISH-1002, 38.[7] This was more than two weeks after the reply period expired.

MPEP §711.01 specifies that an applicant's failure to timely respond to such a notice is not forgiven by filing an abandonment request:

> A letter of express abandonment which is not timely filed (because it was not filed within the period for reply), is not acceptable to expressly abandon the application. . . .
> The letter of express abandonment should be placed…in the application file but not formally entered. . . .
> The application should be pulled for abandonment after expiration of the minimum permitted period for reply (see MPEP § 711.04(a)) and applicant notified of the abandonment for failure to reply within the statutory period.

MPEP §711.04(a) explains the abandonment timeline:

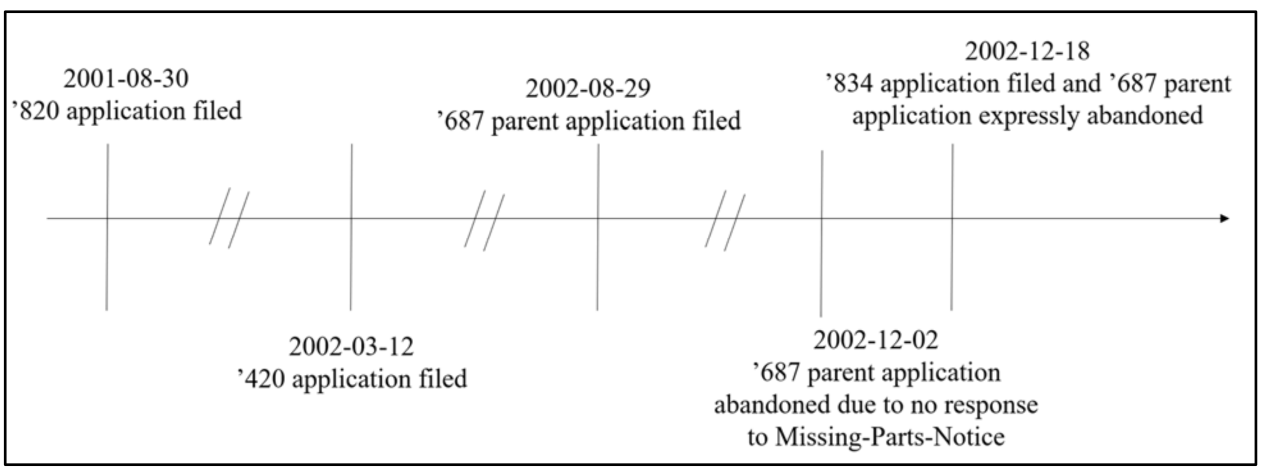
> Although the abandoned files are not pulled until the maximum permissible period for which an extension of time under 37 CFR

[7] Citations to stamped page numbers.

1.136(a) plus 1 month has expired, the date of the abandonment is after midnight of the date the period for reply actually expired.

This precisely mirrors the situation here. On 2004-01-22, *i.e.*, after "the maximum permissible period for which an extension of time … plus 1 month has expired," the USPTO mailed a notice of abandonment in the '687 parent application. Instead of citing the Abandonment Request as the reason for abandonment, the notice stated that the application "is abandoned for failure to timely or properly reply to the Notice to File Missing Parts … mailed on 10/01/2002." DISH-1003, 39.

As a result, as summarized in the figure below, the '687 parent application became abandoned 16 days before (2002-12-02) the filing of the '834 application (2002-12-18), and the two applications were never copending. Therefore, the '518 patent is not entitled to claim priority to the '687 parent application.



2. The ’518 patent’s ’834 application cannot independently claim priority to the ’820 provisional

Because the ’834 application was filed on 2002-12-18, *i.e.*, more than 12 months after the 2001-08-30 filing date of the ’820 provisional, the ’834 application is not entitled to claim priority to the ’820 provisional. MPEP §201.11. Thus, the ’518 patent’s earliest possible priority date is the 2002-03-12 date of the ’420 provisional.

D. Prosecution History Summary

The ’834 application’s examination was short as the application was allowed without an office action being issued. *See generally* DISH-1002.

Following a restriction requirement (*id.*, 15-20) and election of claims by Applicant (*id.*, 9-12), the Examiner indicated that the claims would be allowable if claim 1 were amended to incorporate the subject matter of claim 2 (*id.*, 9). Applicant accepted and the application was allowed. *Id.*, 1-8. Claim 2 recited the features now found in elements [1d.i]-[1d.ii]. *Id.*, 10. In the Notice of Allowance, the Examiner stated:

> The prior art … fails to disclose a network device for communicating data to other network devices by utilizing unique method step of **determining channel characteristics and a bit loading profile used to transmit data by analyzing received probe message signals**.

Id., 6; DISH-1004, ¶¶45-50.

E. Level of Ordinary Skill in the Art

A POSITA would have a degree in electrical engineering, computer engineering, or a related field and experience working in signal processing and/or communication systems/networks, *e.g.*, a bachelor's and three or more years of experience; a master's and at least one year of experience; or a doctorate and some work experience. Additional education could substitute for professional experience, or *vice versa*. DISH 1004, ¶¶22-23.

IV. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. GROUND 1: Claims 1 and 3 are Rendered Obvious by Kliger and Isaksson

1. Kliger

(a) Kliger has an effective filing date of at least 2001-06-11

Kliger is a publication of a U.S. patent application that was filed 2001-08-30 and claims the benefit of five provisional applications ("Kliger Provisionals") each of which predates the Critical Date. DISH-1007, Cover. The earliest provisional, U.S. Provisional Appl. No. 60/229,263, was filed 2000-08-30, exactly 12 months before the Critical Date. *Id.* The following table lists the Kliger Provisionals and their filing dates. DISH-1004, ¶¶51-52.

Provisional	Filed
’263-Provisional (DISH-1008)	2000-08-30
’110-Provisional (DISH-1009)	2000-09-05
’060-Provisional (DISH-1010)	2001-03-12
’130-Provisional (DISH-1011)	2001-05-15
’304-Provisional (DISH-1012)	2001-06-11

Kliger qualifies as prior art to the ’518 patent based on its 2001-08-30 filing date because, as explained above, the earliest possible priority date for the ’518 patent is 2002-03-12. Kliger further qualifies as prior art based on the filing dates of the Kliger Provisionals. *See Dynamic Drinkware, LLC v. National Geographics, Inc.*, 800 F.3d 1375, 1381 (Fed. Cir. 2015). In accordance with *Dynamic Drinkware*, the Kliger Provisionals provide clear and unambiguous support for at least Kliger’s claims 1, 27. DISH-1004, ¶¶51-52. The following table identifies exemplary support in the Kliger Provisionals for each limitation of Kliger’s claims 1 and 27, as confirmed by the testimony of Dr. Williams (*id.*).[8] Accordingly, Kliger is entitled to the Kliger Provisionals’ filing dates. *Id.*; *Huawei Techs. Co., Ltd. v. WSOU Invs., LLC*, IPR2021-00222, Paper 10, 40-42 (PTAB

[8] The Kliger Provisionals citations are to the stamped page numbers.

Feb. 17, 2016) (citing *Dynamic Drinkware* and *Ex Parte Mann*, IPR2015-003571, 2016 WL 7487271 (PTAB Dec. 21, 2016)).

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
1. A home network, comprising:	DISH-1008, p. 5 ("a 'no-new-wires' home-network"), pp. 6-7; DISH-1009, pp. 3-5; DISH-1010, pp. 4-5; DISH-1011, p. 4; DISH-1012, p. 5; DISH-1004, ¶¶51-52.
a network backbone;	DISH-1008, p. 5 ("existing in-house cable TV coax wiring"), pp. 6-7; DISH-1009, p. 6; DISH-1010, p. 5; DISH-1011, pp. 6-8; DISH-1012, p. 6; DISH-1004, ¶¶51-52.
a plurality of modules connected to the network back-bone,	DISH-1008, p. 10 ("Data Module"), p. 11 ("Audio/Video Module"), pp. 6-7; DISH-1009, p. 8; DISH-1010, p. 4; DISH-1011, pp. 4-6; DISH-1012, pp. 5-6; DISH-1004, ¶¶51-52.
each module being connected between the network backbone and a local bus, and	DISH-1008, p. 10 ("The DM is connected between the Coax outlet and a data port of a data device"), p. 11 ("bridge unit"), p. 7; DISH-1009,

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
	p. 13; DISH-1010, p. 4; DISH-1011, p. 7 ("home network embodiment consisting of several local buses and a backbone network."), p. 5; DISH-1012, p. 6; DISH-1004, ¶¶51-52.
a demarcation point unit	DISH-1008, p. 7 ("residential gateway (TRG)"), ("The TRG is installed in the demarcation point of the cable TV network"); DISH-1009, p. 9; DISH-1010, p. 4; DISH-1011, p. 5; DISH-1012, p. 6; DISH-1004, ¶¶51-52.
receiving a home network signal from one of the modules over the network backbone and passing the home network signal to the plurality of modules.	DISH-1008, p. 10 ("Each of the network devices … connect[s] one to the other through … the TRG"); DISH-1009, p. 12; DISH-1010, p. 4; DISH-1011, p. 4; DISH-1012, p. 6; DISH-1004, ¶¶51-52.
27. A demarcation point unit connected between a home	DISH-1012, p. 6 ("The home network … employs an embodiment residing at the demarcation point

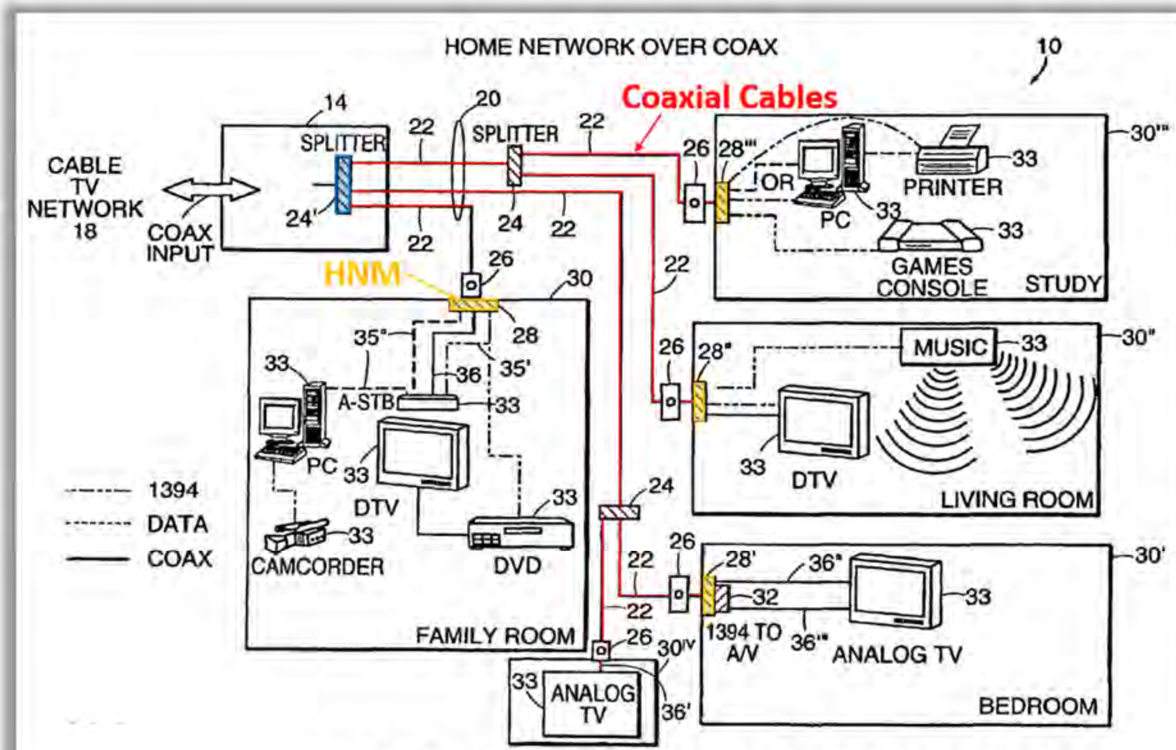
Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
network backbone and an external network, the demarcation point unit comprising:	… named Demarcation unit or DU. The DU … separates the home network signals from the outside cable plant.”); DISH-1004, ¶¶51-52.
a diplexer receiving a home network signal from the home network backbone and an external signal from the external network, the diplexer separating the home network signal from the external signal; and	DISH-1012, p. 7 (Figure 5 showing a DU that includes a diplexer (DIP) that receives a home network signal from “In home wires” and external signal from “outside plant.” The DIP separates the in-home signal from the outside signal by routing the in-home signal to the “Home Network Reflector Unit [HRU]”); DISH-1004, ¶¶51-52.
a signal reflector unit receiving the home network signal from the diplexer and returning the home network signal back to the home	DISH-1012, p. 7 (The HRU receives the home-network signals from DIP and reflects them back into the house to the in-home wires); DISH-1004, ¶¶51-52.

Kliger (Claims 1, 27)	Exemplary Support from the Kliger Provisionals
network backbone.	

Even beyond the support for Kliger's claims, the evidence confirms that Kliger's teachings cited herein against the '518 patent were taught in the Kliger Provisionals. *Infra*, §IV.A.4-5 (citing DISH-1007 and the corresponding portions of DISH-1008 through DISH-1012); *see also Ex Parte Mann*, 2016 WL 7487271, at *6; *Huawei*, IPR2021-00222, Paper 10, 40-42. Thus, the Kliger Provisionals describe the subject matter relied upon as prior art in Kliger, and Kliger qualifies as prior art to the '518 patent under at least 35 U.S.C. § 102(e). *See Dynamic Drinkware*, 800 F.3d at 1380-81; DISH-1004, ¶¶51-52 and ¶¶83-144.

(b) Overview

Kliger discloses a home network implemented on "cable TV equipment … already installed in many homes." DISH-1007, ¶0041, FIG. 1; DISH-1008, 6-7; DISH-1012, 5-6; DISH-1004, ¶53.



KLIGER FIG. 1 (Annotated); DISH-1008, 7

Kliger's home network 10 includes "a demarcation point unit (DPU) 14 located at the entry point into a home." DISH-1007, ¶0040; DISH-1008, 7; DISH-1012, 6. The DPU 14 "operates as the interface between the home network 10 and an external network 18, such as a cable television (TV) network." DISH-1007, ¶0040; DISH-1008, 7; DISH-1012, 6. Additionally, the "DPU 14 is in communication with a plurality of home-network modules (HNM) 28, 28', 28'', 28''' (generally 28)." DISH-1007, ¶0040; DISH-1008, 7; DISH-1011, 6-7. Kliger teaches its HNMs can provide internet access using a cable modem or DSL services. DISH-1007, ¶¶0043, 0050; DISH-1008, 5, 9; DISH-1012, 6; DISH-1004, ¶55.

Each HNM, shown above in orange, is an "interface between devices in a room (e.g., home entertainment devices and computer devices) and the DPU 14." DISH-1007, ¶0040; DISH-1008, 6-7, 10-11; DISH-1011, 5; DISH-1012, 6. Kliger's HNMs 28 communicate with the DPU 14 and with each other over standard cable equipment that includes coaxial cables 22 (red), splitters 24 (blue), and cable TV outlets 26. DISH-1007, ¶0041; DISH-1008, 7; DISH-1010, 5; DISH-1012, 5-7; DISH-1004, ¶56.

Kliger explains that "[i]n each room 30 having a device 33 that the resident of the home wants to make available for intra-room communication, there is located a HNM 28 that connects that device 33 to the backbone 20." DISH-1007, ¶0044; DISH-1008, 6-7, 10-11; DISH-1010, 5. In this arrangement, "[e]ach HNM 28 communicates with … each other HNM 28 on the backbone 20 with analog signals and converts analog signals received from … the HNMs 28 into digital signals for delivery to devices 33 connected to that HNM 28." DISH-1007, ¶0047; DISH-1008, 10-11. To do so, the HNMs use multi-carrier signaling, and specifically "an efficient modulation scheme, like … OFDM[] or … DMT." DISH-1007, ¶0073; DISH-1009, 6; DISH-1010, 4; DISH-1004, ¶¶56-57.

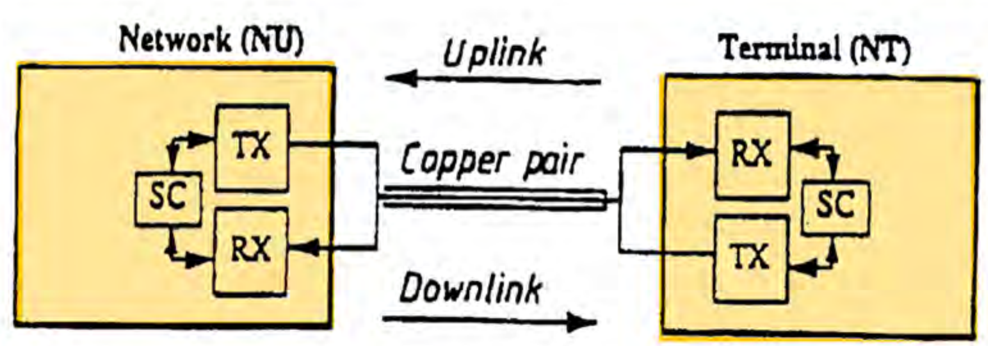
2. Overview of Isaksson

Isaksson is a PCT application that published 1998-03-12 and qualifies as prior art at least under §102(b). DISH-1013, Cover; DISH-1004, ¶58.

Isaksson describes "multi-carrier transmission systems having the facility to dynamically change carrier bit-loading." DISH-1013, 1:3-7. Like Kliger, Isaksson discusses using multi-carrier modulation as a "modulation system" for high bit-rate traffic transmission schemes, such as DSL. *Id.*, 1:8-18. Like the '518 patent, Isaksson's multi-carrier system uses "bit-loading techniques [in which] the number of transmitted bits per symbol is adapted, or regulated, to the signal-to-noise ratio (SNR) of the current carrier." *Id.*, 3:24-27; DISH-1001, Abstract; DISH-1004, ¶59.

Isaksson observes that adapting the number of bits to SNR "dynamically affects … the total bandwidth of the system." DISH-1013, 3:27-28. "This variation in bandwidth leads to an absolute system requirement for synchronous configuration of the transmitter and the receiver, in terms of the number of coded/decoded bits per symbol and carrier wave. If this requirement is not met, the system will be unable to maintain a connection." *Id.*, 3:29-34; DISH-1004, ¶60.

Isaksson proposes "a multi-carrier transmission system having a first and a second transceiver," as shown below, where each transceiver (orange) has a receiver and a transmitter. DISH-1013, 5:14-6:1.



ISAKSSON FIG. 22 (Annotated)

In this system, "[t]he Signal-to-Noise Ratio is calculated for each carrier." *Id.*, 54:13-24. To do so, each "receiver continuously measures and estimates the characteristics and changes of/in the channel." *Id.*, 4:4-6. The "[c]hannel characteristics may be estimated by periodic transmission, by one of said transceivers, of a base sync frame having a predetermined content and comparing, in the other of said transceivers, the received sync frame with a reference frame." *Id.*, 16:8-12. The receivers (in both transceivers) then send information related to the measurements to the transmitter in the uplink transceiver. *See id.*, 77:21-79:4; DISH-1004, ¶¶61-62.

"Based on the Signal-to-Noise Ratios, bit-loading factors are calculated for each carrier." DISH-1013, 54:16-21; *see also id.*, 5:14-6:1. Then, the "multi-carrier system is adapted to synchronously update, at said first and second transceivers, the bit loading parameters associated with each channel." *Id.*, 5:14-6:1; *see also id.*, 54:13-21. DISH-1004, ¶63.

3. Combination of Kliger and Isaksson

The Kliger-Isaksson combination incorporates Isaksson's synchronized bit-loading in the modems of a multi-carrier system into Kliger's home network, which includes modems, Kliger's HNMs, that use multi-carrier signaling for inter-modem communications. DISH-1004, ¶64. Isaksson's techniques enable Kliger's HNMs to overcome signal impairments and determine carrier availability for the inter-modem signaling. *Id.*

Kliger and Isaksson are in the same field of endeavor of networking systems, and both teach techniques for high-speed communication on wired networks to support broadband services, *e.g.*, Internet services. DISH-1007, ¶¶0043, 0050; DISH-1013, 1:3-18; DISH-1004, ¶64.

(a) Motivation

A POSITA seeking to implement Kliger's network would have understood that Kliger's inter-modem signaling is subject to signal impairments, like interference and noise. Specifically, "[r]eflections can occur at the splitter, resulting in inter-symbol interference to the home network signal." DISH-1007, ¶0073; DISH-1010, 5; DISH-1004, ¶65. And, as explained by Dr. Williams, Kliger's inter-modem signaling is subject to external noise. DISH-1004, ¶66.

Furthermore, a POSITA would have understood that Kliger's network conditions are dynamic due to the addition/removal of network devices and/or

changing external conditions. *Id.*, ¶67. Indeed, Kliger contemplates the addition/removal of network devices to the home network. *Id.* The dynamic nature of the network conditions means that the carriers used in the multi-carrier signaling are subject to variable conditions. Consequently, a carrier that was once clear of interference can later become overwhelmed with interference. *Id.*

In view of these challenges, a POSITA would have been motivated to improve Kliger's multi-carrier signaling using Isaksson, which addresses the dynamic nature of multi-carrier signaling on wired networks. *Id.*, ¶68.

Isaksson recognizes and addresses overcoming losses and noise using multi-carrier modulation techniques, *e.g.*, DMT. *See* DISH-1013, Abstract. Isaksson explains, "[a] multi-carrier modulation technique, such as DMT, handles frequency dependent loss and noise … in an efficient manner." *Id.*, 26:4-20. Isaksson's multi-carrier techniques do so using bit-loading where the "allocated transmission power for the individual carriers depends on the noise power and the transmission loss in each band." *Id.* Specifically, "[i]f a carrier has a high SNR, up to 12 bits are placed on that carrier," "[f]or carriers with low SNR values, fewer bits are placed on the carrier," and "[c]arriers affected by narrowband interferers are turned off." *Id.*; DISH-1004, ¶69.

Isaksson also recognizes that regulating bit-loading based on "signal-to-noise ratio (SNR) of the current carrier wave … affects, in time, the total

bandwidth of the system." DISH-1013, 3:24-34. "This variation in bandwidth leads to an absolute system requirement for synchronous configuration of the transmitter and the receiver, in terms of the number of coded/decoded bits per symbol and carrier wave. If this requirement is not met, the system will be unable to maintain a connection." *Id.* Isaksson teaches a solution "in which synchronism between two transceivers is maintained during dynamic system reconfiguration of bit-loading factors." *Id.*, 4:21-25; DISH-1004, ¶70.

A POSITA would have been motivated to use Isaksson's multi-carrier teachings to improve Kliger's network. DISH-1004, ¶71. **First**, Kliger's HNMs would determine the number of bits-per-carrier based on SNR and turn off carriers affected by interferers, thereby handling frequency dependent loss and noise by sending fewer or no bits on noisy carriers. DISH-1013, 26:4-20; DISH-1004, ¶72. **Second**, Kliger's HNMs would update bit-loading such that the HNMs are aware of the bit-loading parameters assigned to the carriers of the channels between the HNMs. In addition to enabling Kliger's HNMs to determine carrier availability for inter-modem signaling, this would prevent the connections between the HNMs from failing due to one HNM sending more/fewer bits-per-carrier than another HNM expects. DISH-1013, 4:1-20; DISH-1004, ¶¶71-73.

Isaksson's bit-loading techniques determine the bits-per-carrier based on each carrier's respective channel characteristics. DISH-1013, 3:24-34.

Accordingly, Kliger's HNMs would determine each carrier's characteristics to determine that carrier's number of bits. To do so, each Kliger HNM—as a transmitter—would transmit base sync frames having predetermined content to the other HNMs over respective channels between the HNMs. The other HNMs—as receivers—would analyze the received base sync frames to determine channel characteristics of the respective channels. The transmitter HNM would obtain information about the channel characteristics, *e.g.*, SNR, from the receiver HNMs and select the bit-loading parameters for the respective channels based on the received information. The transmitter HNM would then communicate the bit-loading parameters to the receiver HNMs. DISH-1004, ¶74.

A POSITA would have considered the Kliger-Isaksson combination to be an example of: (1) use of known techniques (Isaksson's synchronized bit-loading that involves modems transmitting, receiving, and analyzing base sync frames for determining channel conditions to select bit-loading parameters) to improve similar devices in the same way (overcoming interference and maintaining connections with other modems); (2) a teaching, suggestion, or motivation in Isaksson that would have led a POSITA to implement Kliger with Isaksson's synchronized bit-loading; and (3) combining prior art elements (Isaksson's synchronized bit-loading) according to known methods to yield predictable results (Kliger's HNMs using multi-carrier signaling with synchronized bit-loading). *Id.*, ¶75; *see KSR*

Int'l Co. v. Teleflex Inc., 550 U.S. 398, 415-421 (2007).

Additionally, a POSITA would have understood that Kliger and Isaksson are analogous art to the '518 patent because they are from the same field of endeavor as the patent—wired networking systems—and because they are reasonably pertinent to the problem at issue in the patent—overcoming wired-network signal impairments. DISH-1004, ¶¶76-80.

(b) Reasonable Expectation of Success

A POSITA would have had a reasonable expectation that the Kliger-Isaksson combination would produce a successful outcome. Indeed, a POSITA would have a reasonable expectation of success in implementing Isaksson's wired-network bit-loading solutions into Kliger's wired network. Although Isaksson's network is non-coaxial, Isaksson expressly extends its solutions to other systems, and to coaxial networks specifically. *See* DISH-1013, 72:5-8 ("the present invention can be used not only with the [described] system … but with other multi-carrier systems"), 3:4-15 ("the DAVIC specification … enable[s] premises distribution of VDSL signals over coaxial cable systems"); DISH-1004, ¶¶81-82.

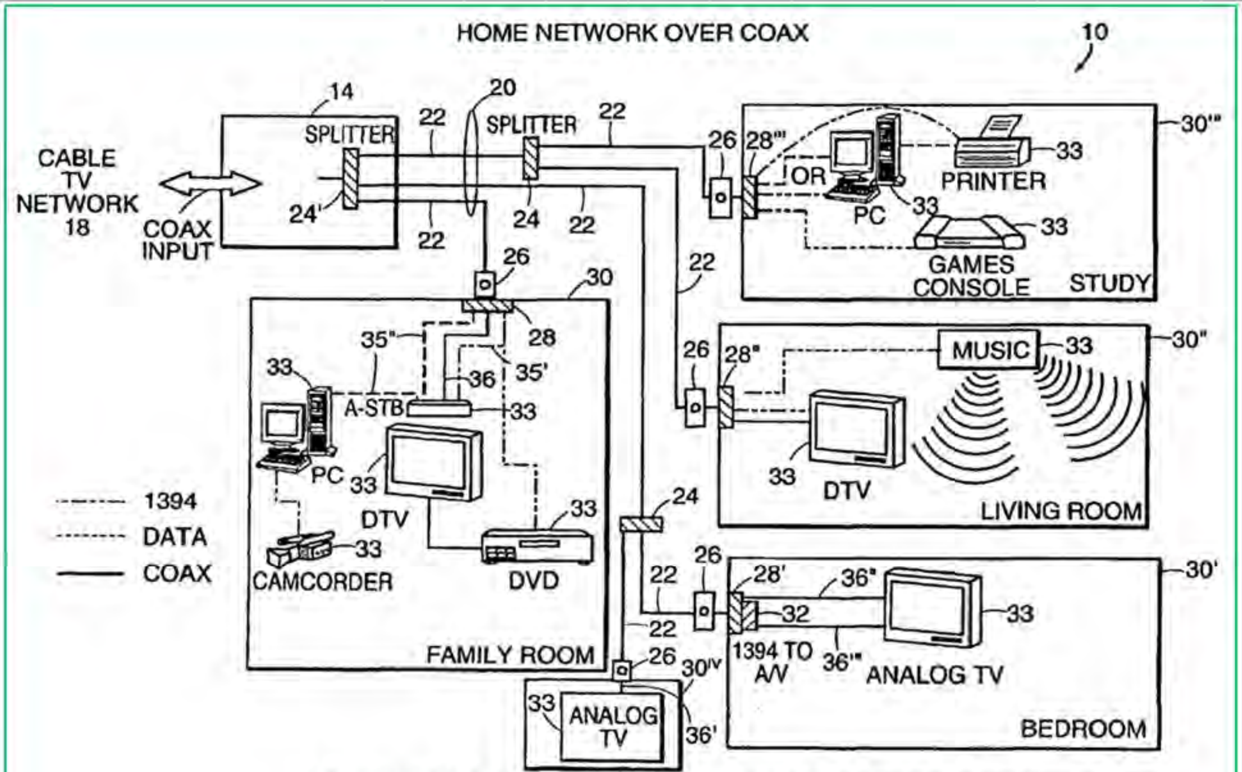
Because Kliger's home network uses multi-carrier modulation, a POSITA would have reasonably expected Isaksson's teachings of multi-carrier modulation to work in the context of Kliger's network. *Id.*, ¶¶83-84. Implementing Isaksson's multi-carrier improvements would have been within the skill level of a POSITA

because this modulation is used in many applications and taught in a variety of engineering courses that a POSITA would have taken. *Id.* Using Isaksson's improvements in Kliger's network would have predictably resulted in improved multi-carrier signaling between Kliger's HNMs, by controlling the bit-loading based on channel characteristics to overcome noise and synchronizing bit-loading parameters between the modems to maintain connectivity. *Id.*

4. Claim 1

[1pre]

To the extent the preamble is limiting, Kliger discloses [1pre]. Kliger teaches a "**network**[] suitable for use in residential buildings." DISH-1007, ¶0002; DISH-1008, 5. Kliger's Figure 1, reproduced below, illustrates a home network 10 (green). DISH-1007, ¶0002, ¶0040; DISH-1009, 9; DISH-1004, ¶¶85-91.



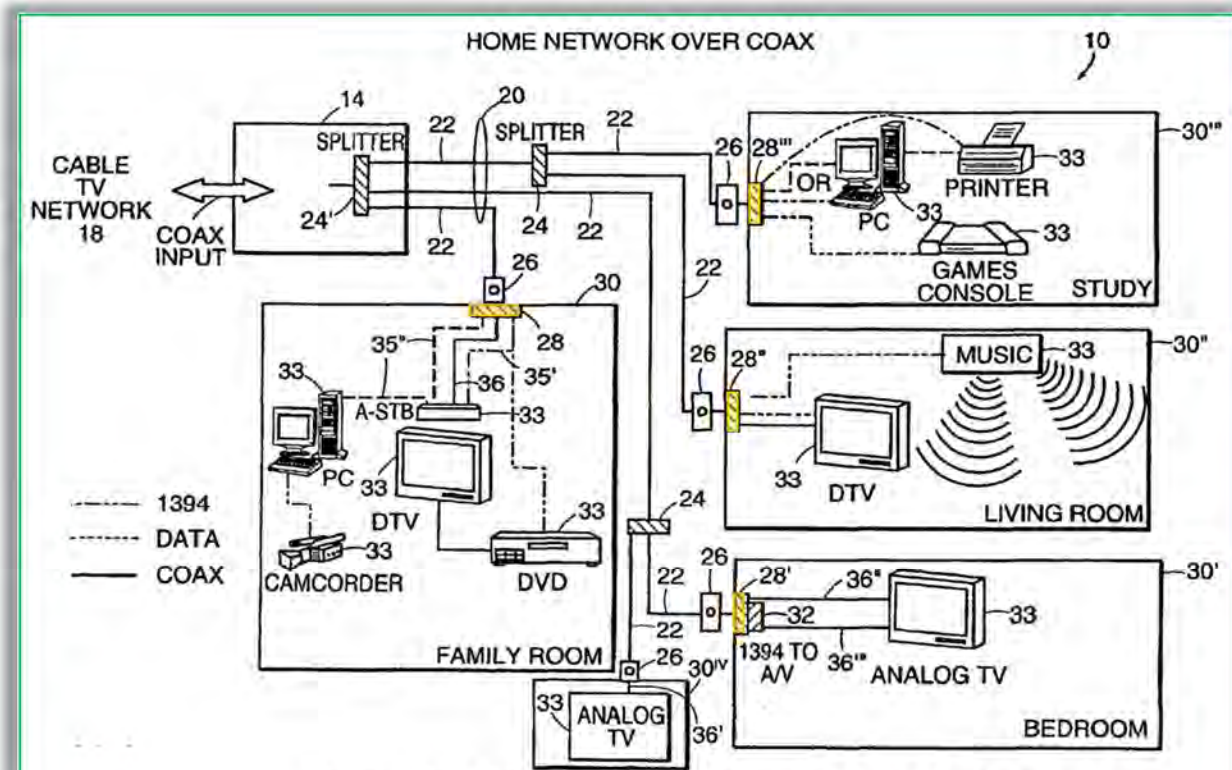
KLIGER FIG. 1 (Annotated); DISH-1008, 7

[1a.i]

Kliger discloses "a home network including a demarcation point unit and a plurality of modules." DISH-1007, ¶0010; DISH-1008, 7, 10-11. Each of the plurality of modules, *i.e.*, ***at least two network devices***, "is connected to the demarcation point unit by one or more coax cables and to a device by a local bus." DISH-1007, ¶0010; DISH-1008, 7; DISH-1011, 7; DISH-1004, ¶¶92-93.

Kliger's Figure 1, shown below, illustrates the home network 10 that includes a plurality of home-network modules (HNMs) 28, 28', 28", 28'" (generally

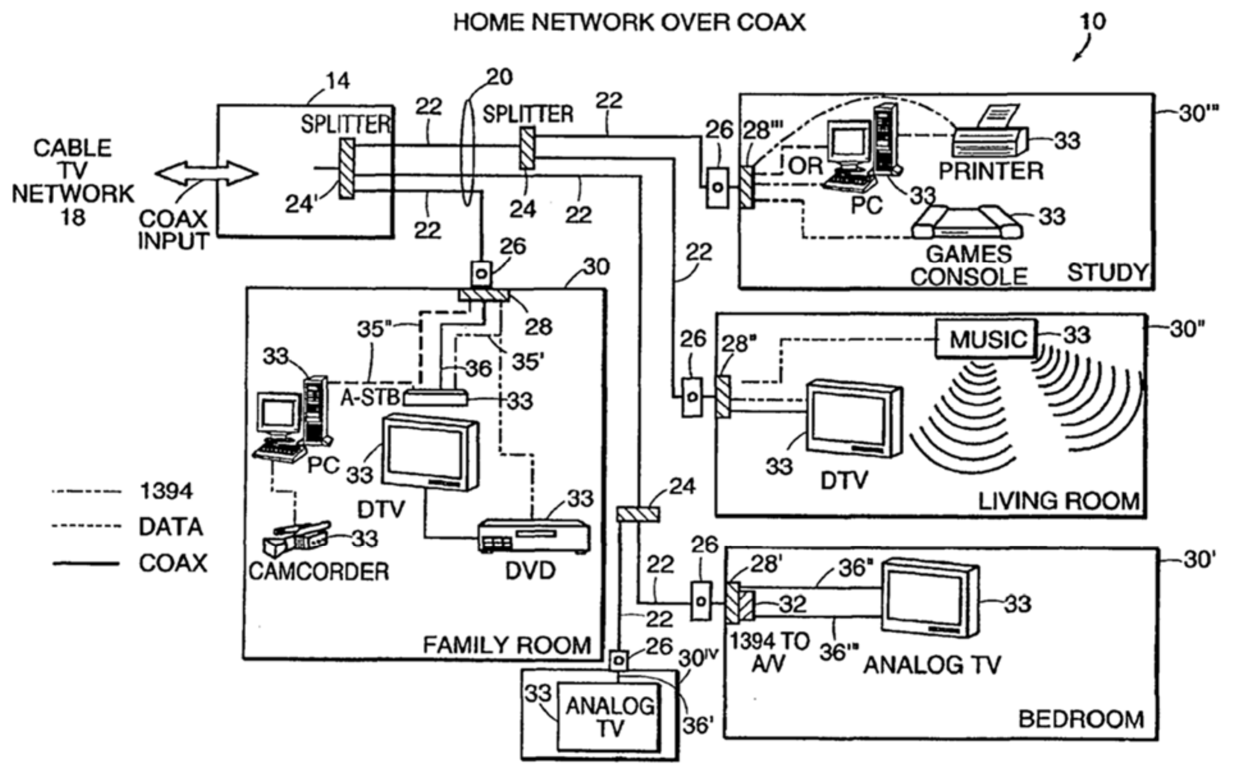
28, orange). DISH-1007, ¶0043, FIG. 1; DISH-1008, 7, 10-11; DISH-1004, ¶¶94-97.



KLIGER FIG. 1 (Annotated); DISH-1008, 7

[1a.ii]

As discussed, Kliger discloses a data communication network 10 in which the HNMs 28 communicate with each other to deliver data. *See* element [1pre], *supra*.

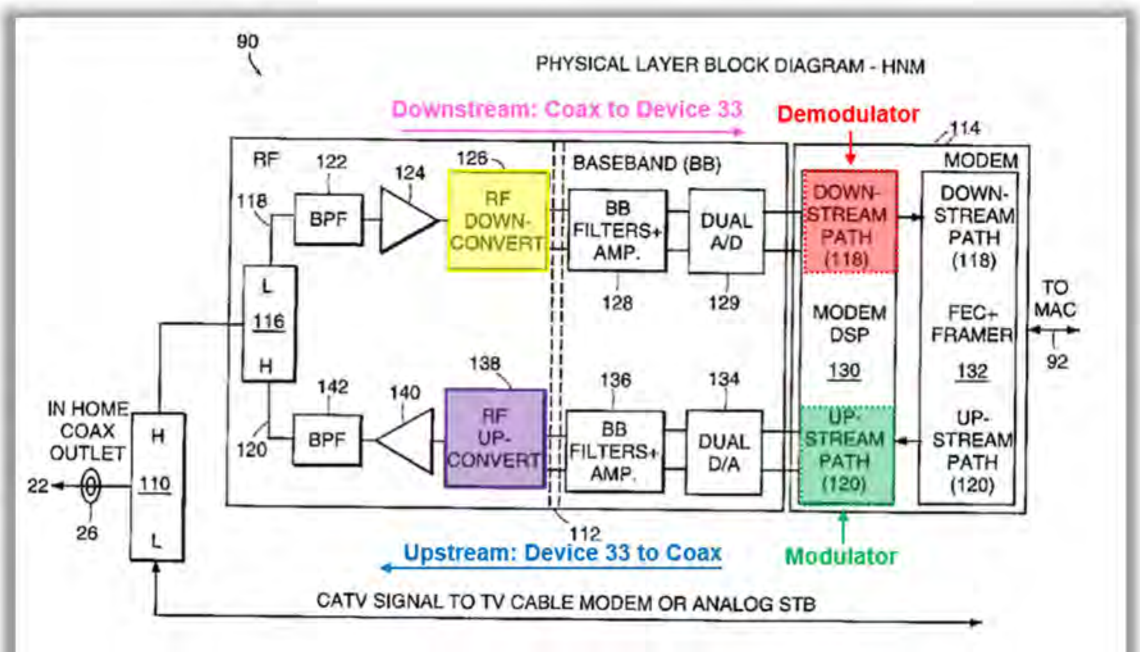


KLIGER FIG. 1 (Annotated); DISH-1008, 7

To transmit data upstream, "the HNM 28 receives a signal from a device 33 through a data port and converts that signal into a modulated analog signal" for transmission "over the backbone 20." DISH-1007, ¶0065; DISH-1008, 10. Kliger teaches that the modulated analog signal, also called a "home network signal," is "modulated as a multi-carrier signal." DISH-1007, ¶¶0073 (the HNM's modem 114 uses an efficient modulation scheme like OFDM or DMT), 0170 ("…the signal is modulated as a multi-carrier signal"); DISH-1009, 6, 12; DISH-1010, 4. In the other direction, the HNM 28 receives the home network signal over the backbone 20 and converts it into a data signal. DISH-1007, ¶0065; DISH-1008, 10. Thus, Kliger's HNMs 28 communicate using multi-carrier signaling. DISH-

1004, ¶¶98-101.

In Figure 4, Kliger explains how the HNMs 28 transmit and receive home network signals at the physical layer 90. *Id.*, ¶102. Layer 90 includes the upstream path 120 communicating with the backbone 20 via cable 22, and the downstream path 118 receiving signals from the backbone 20. *See* DISH-1007, ¶0070; DISH-1009, 12-13; DISH-1010, 4; DISH-1004, ¶103.



KLIGER FIG. 4 (Annotated); DISH-1010, 4

Starting with the upstream path 120 (blue), the framer 132 receives data bits from the MAC 92. DISH-1007, ¶0080; DISH-1008, 10. The framer 132 passes a data signal including the data bits to the DSP 130, which modulates the data signal using multi-carrier modulation. DISH-1007, ¶0078 ("[in] the modem 114, I/Q modulation occurs at the DSP 130"); *see also id.*, ¶0073 (the modem 114 uses an

efficient modulation scheme like OFDM or DMT); DISH-1009, 6; DISH-1010, 4-5. Because Kliger's DSP 130 modulates the data signal using multi-carrier modulation, a POSITA would have understood that the DSP 130 includes the claimed "multi-carrier modulator for modulating data." DISH-1009, 4, 6, 12-13; DISH-1010, 4-5; DISH-1004, ¶104.

Kliger teaches converting the modulated signal to an analog baseband signal, which "then is up-converted by the **RF up conversion circuitry 138**," in purple above, "**to the upstream frequency band**," *i.e.*, the claimed "an up converter for translating the modulated data to an RF carrier frequency." DISH-1007, ¶0075; DISH-1009, 5-6; DISH-1010, 4. Kliger's frequency band is "in the 960 to 1046 MHz frequency range." DISH-1007, ¶0061; DISH-1010, 4-5. The RF up-converted signal is combined with the CaTV signal for transmission over the backbone 20. *See* DISH-1007, ¶0075; DISH-1009, 6; DISH-1010, 4; DISH-1004, ¶¶105-106.

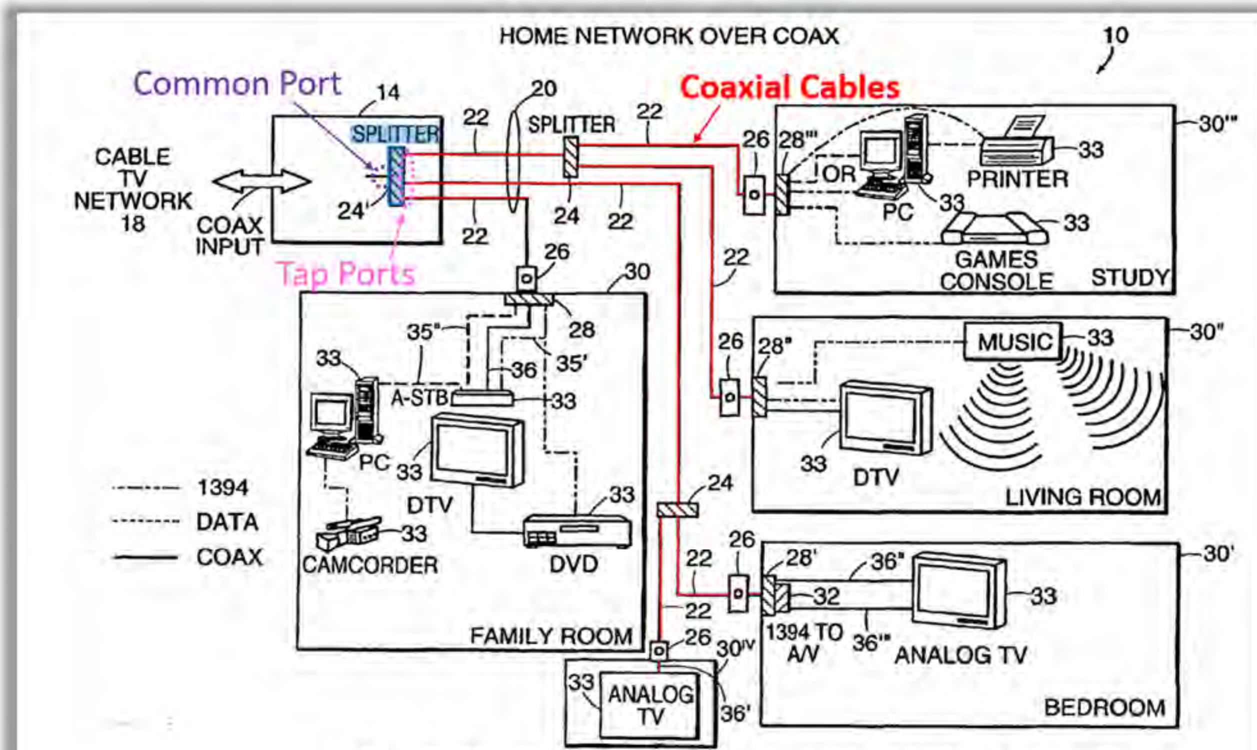
Turning to Kliger's downstream path 118, "[t]he diplexer 110 … separates the CaTV signal (frequencies 5-860 MHz) from the home network signal," and "[t]he home network signal passes to the RF unit 112." DISH-1007, ¶0069; DISH-1010, 4. "The downstream signal passes through … **RF down-conversion circuitry 126** [yellow]," which "**converts the downstream signal to baseband frequencies**," *i.e.*, the claimed "a down converter for translating an RF signal."

DISH-1007, ¶0071; DISH-1009, 5; DISH-1010, 4; DISH-1004, ¶107.

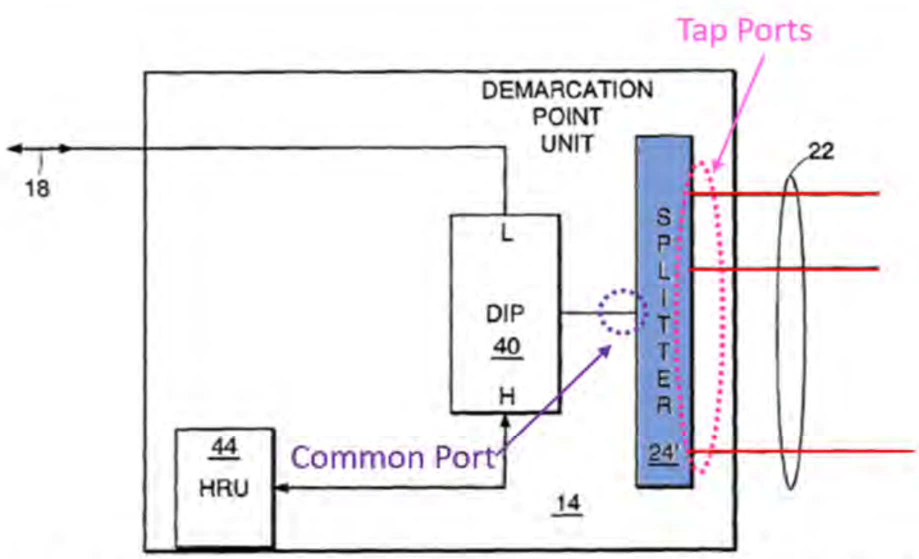
The baseband signal then passes to the DSP 130 that demodulates the signal to produce data from the transmitted data bits. DISH-1007, ¶0078 ("I/Q modulation occurs at the DSP 130"); *see also id.*, ¶0081; DISH-1009, 12; DISH-1010, 4. Because the DSP 130 can implement demodulation and because the home network signal is a multi-carrier signal, a POSITA would have understood that Kliger's DSP 130 also includes a multi-carrier demodulator (red) for demodulating the home network signal to produce the data bits in the signal, *i.e.*, the claimed "a multi-carrier demodulator for demodulating the translated RF signal to produce data." DISH-1004, ¶¶108-111; DISH-1001, 9:22-27 (disclosing inverse operations of modulators were "well known in the art").

[1b]

Kliger discloses that implementing its "network 10 in the home does not require the rewiring of the cable TV equipment that is typically already installed in many homes for accessing the cable TV network 18 or the Internet." DISH-1007, ¶0041; DISH-1008, 6. Thus, like the '518 patent, Kliger's "HNMs 28 communicate with the DPU 14 and with each other over standard cable equipment," which "includes **coaxial (or coax) cables 22, splitters (generally 24),** and cable TV outlets 26." DISH-1007, ¶0041; DISH-1008, 7; DISH-1012, 5, 7; DISH-1001, Abstract; DISH-1004, ¶¶112-115.



KLIGER FIG. 1 (Annotated); DISH-1008, 7



KLIGER FIG. 2 (Annotated); DISH-1012, 7

As shown above in Figures 1-2, Kliger's DPU 14 includes a splitter 24' that

has an input port (purple, "common port") and a plurality of output ports (pink, "tap ports"). DISH-1004, ¶116-117. Coaxial cables 22 (red), which include a plurality of segments, connect between the output ports of the splitter 24' and the HNMs 28. Each of the other splitters 24 have similar features. *Id.*

[1c]

As discussed, Kliger's HNMs each include a multi-carrier modulator for generating multi-carrier signals and multi-carrier demodulators for processing received multi-carrier signals. *See* element 1a.ii, *supra*.

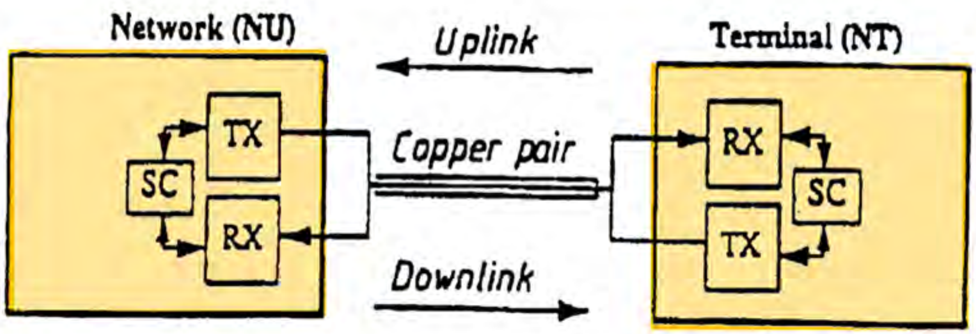
Kliger further discloses that the "HNMs 28 communicate with the DPU 14 and with each other **over standard cable equipment**," which "includes **coaxial (or coax) cables 22, splitters (generally 24),** and cable TV outlets 26." DISH-1007, ¶0041; DISH-1008, 7, 10. The coax cables "distribute the signals received from the external network 18 and from the HNMs 28 to the rooms 30." DISH-1007, ¶0043; DISH-1009, 6; DISH-1004, ¶¶118-120.

Because the HNMs communicate using multi-carrier signaling and communicate with each other over cable wiring, a POSITA would have understood that the communication between the HNMs through the cable wiring is multi-carrier signaling, *i.e.*, the claimed "network devices communicate with each other through the cable wiring using multi-carrier signaling." DISH-1004, ¶¶121-123.

[1d.i]

As discussed, Kliger's HNMs communicate with each other using multi-carrier signaling. *See* element [1bi], *supra*.

Isaksson describes "a multi-carrier transmission system" that includes two multi-carrier transceivers/modems (orange), where each transceiver has a receiver and a transmitter. DISH-1013, 1:1-18; DISH-1004, ¶¶124-127.



ISAKSSON FIG. 22 (Annotated)

In Isaksson's multi-carrier system, each receiver "continuously measures and estimates the characteristics and changes of/in the channel." DISH-1013, 4:1-8. The characteristics are "estimated by periodic transmission, by one of said transceivers, of a base sync frame having a predetermined content and comparing, in the other of said transceivers, the received sync frame with a reference frame." *Id.*, 16:8-12; *see also id.*, 10:10-14. By comparing the received frame with the reference frame, the receiver "estimate[s] the characteristics of the channel, over which the frame is transmitted, in terms of attenuation, phase shift and variance." *Id.*, 79:5-14. A POSITA would understand that to estimate a channel's

characteristics, the receiver would compare a signal of the received frame to the reference frame to determine the attenuation, phase shift, and variance the signal experienced over the channel. DISH-1004, ¶128.

Isaksson describes that the transceivers periodically transmit the base sync frames at a base sync interval. DISH-1013, 16:15-20. "Additional sync frames may be transmitted at intervals between said base sync frames." *Id.* Therefore, Isaksson's transceivers transmit and receive multiple base sync frames to one another through the cable wiring. DISH-1004, ¶129.

Although Isaksson does not refer to the "base sync frame" as a "probe message," as explained by Dr. Williams, Isaksson's "base sync frame" is effectively identical to the claimed "probe message." *Compare* DISH-1013, 77:27-79:14 (teachings a base sync frame as having "predetermined content") *with* DISH-1001, 9:37-41 (probe messages use "a predetermined bit sequence"). Therefore, Isaksson's "base sync frame" is a "probe message." DISH-1004, ¶130.

As explained, a POSITA would have found it obvious to modify Kliger's home network with Isaksson's synchronized bit-loading. DISH-1013, 4:21-25; DISH-1004, ¶131.

Here, each HNM—as an uplink HNM—would periodically transmit base sync frames, *i.e.*, probe messages, having predetermined content to other HNMs—as downlink HNMs—through coaxial cables (*i.e.*, the claimed "network devices

transmit probe messages through the cable wiring"). DISH-1013, 16:8-12. The downlink HNMs would analyze the received frames by comparing them with reference frames to determine channel characteristics. *Id.*, 79:9-14. In particular, the downlink HNMs would analyze the signals of the received frames to characterize the channel in terms of attenuation, phase shift, and variance, *i.e.*, the claimed "analyze received probe message signals to determine channel characteristics." *Id.*, 16:15-20; DISH-1004, ¶¶132-133.

[1d.ii]

Isaksson also discloses that bit-loading parameters are selected based on the determined channel characteristics. DISH-1004, ¶¶134-136.

In Isaksson's system, "[d]ata is transmitted between the two transceivers using a plurality of carriers." DISH-1013, 25:26-26:20. Isaksson teaches its transceivers can "dynamically chang[e] the number of coded/decoded bits per carrier wave." *Id.*, 4:1-20. To do so, each receiver continuously measures the channel characteristics. *Id.* "From this information, performance for each sub-channel (sub-wave) is identified." Then, based on the information, "reconfigurations of the transmitted number of bits per symbol for each single carrier wave are decided." *Id.*; DISH-1004, ¶137.

Specifically, Isaksson's receivers send information about the measured channels to the Isaksson's transmitter in the uplink transceiver. *See* DISH-1013,

77:27-79:14 (the transmitter "obtains information about measured channels from the uplink and downlink receivers."). Then, Isaksson's transmitter selects "the bit-loading for each carrier wave" and "transmits the bit-loading constellation … to the downlink transceiver." *Id.* The transmitter also changes the bit-loading constellation in the uplink transceiver. *See id.*; DISH-1004, ¶138.

Isaksson discloses that the information based of which Isaksson's system selects bit-loading is SNR. DISH-1013, 3:24-27. Specifically, the "individual carrier's SNR is calculated on the receiver side." *Id.*, 26:12-14. Then "the number of transmitted bits per symbol is adapted, or regulated, to the signal-to-noise ratio (SNR) of the current carrier." *Id.*, 3:24-27. As explained by Dr. Williams, a POSITA would have understood that the receivers can use the "attenuation, phase shift and variance" that they measure to calculate SNR. DISH-1004, ¶139 (citing to DISH-1024).

As discussed in the previous limitation, each of Kliger's HNMs—as uplink HNMs—would periodically transmit base sync frames to other HNMs—as downlink HNMs. DISH-1013, 16:8-12. The downlink HNMs would analyze the received frames to determine channel characteristics. Then, the downlink HNMs would send information about the channel characteristics, e.g., SNR, to the uplink HNM. *See id.*, 77:27-79:14. Then, the uplink HNM would select the bit-loading parameters for the channels based on the information of the determined channel

characteristics, *i.e.*, the claimed "bit loading is selected based on the determined channel characteristics." *Id.*, 4:1-20. DISH-1004, ¶¶140-142.

5. Claim 3

[3a]

Kliger explains that "each HNM 28 permits those devices 33 connected to that HNM 28 to communicate with other devices 33 in different rooms 30, **to receive programming from the cable television**, and to have broadband access to the Internet." DISH-1007, ¶0050; DISH-1008, 10-11; DISH-1009, 5-6. Kliger provides the example of a digital television in the home network 10 receiving programming from the external cable television network 18. DISH-1007, ¶0050, ¶0075 (combining the upstream signal with the CaTV signal for transmission over the home backbone); DISH-1008, 10-11; DISH-1012, 6; DISH-1004, ¶¶143-145.

[3b]

As discussed in element 1a.ii, Kliger discloses an up-converter that translates the modulated data to an RF carrier frequency. *See* element 1a.ii, *supra*.

Kliger discloses that the "CaTV signal (including the signal from Internet providers) is in the frequency range of 5 to 860 MHz." DISH-1007, ¶0061; DISH-1010, 5-6. Conversely, "[t]he home network signal transmitted over the home network backbone 20 is in **the 960 to 1046 MHz frequency range, but other frequency bands above the CaTV signals can be used**." DISH-1007, ¶0061; DISH-1010, 5-6; DISH-1004, ¶¶146-149.

B. GROUND 2: Claims 1 and 3 are Rendered Obvious by Amit, Jacobsen, and Isaksson

1. Overview of Amit

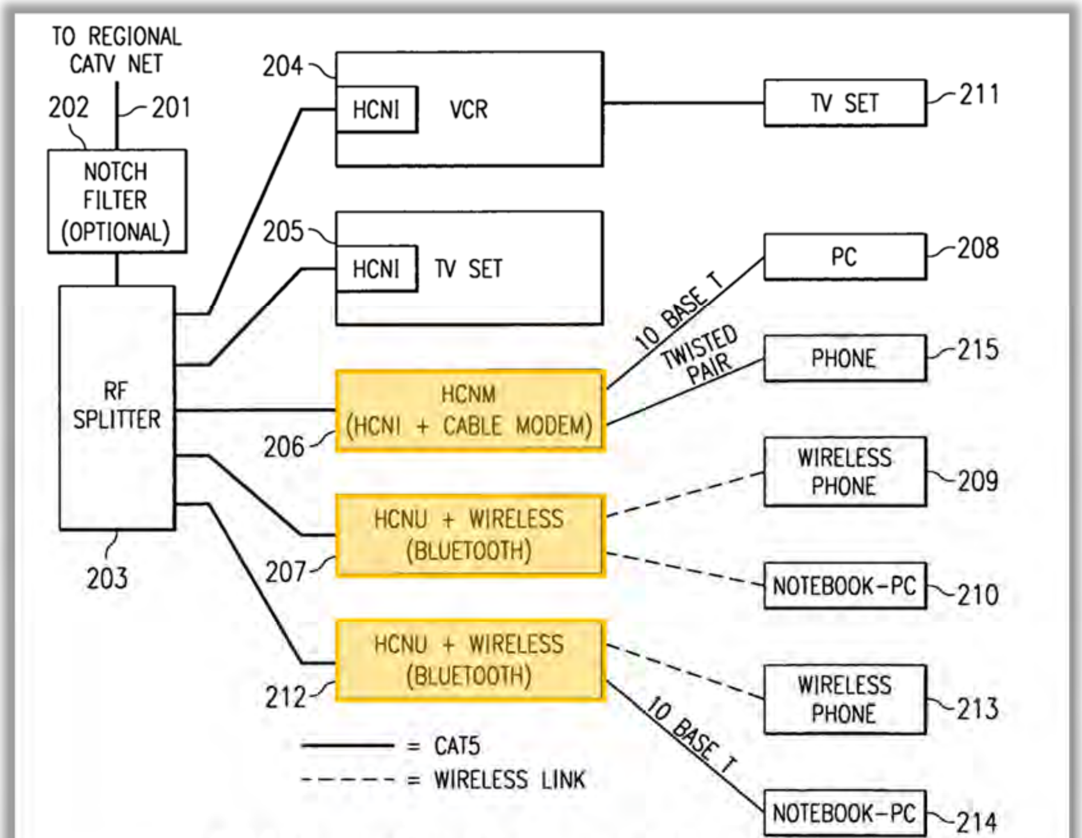
Amit is a U.S. Patent that was filed 2000-04-12 and qualifies as prior art at least under §102(e). DISH-1014, Cover; DISH-1004, ¶150.

Amit discloses "a system and methods for communication between subscribers' devices over cable infrastructure designed to carry video signals." DISH-1014, 2:34-36. Like the '518 patent, Amit teaches how to provide "networking over coaxial TV cables." *Id.*, 2:39-40; *see* DISH-1001, Abstract. Amit's networking "is based on direct communications between two subscribers' devices, without transferring the data via a headend." DISH-1014, 2:63-67; DISH-1004, ¶151.

Amit's home network, called (HomeCN or HCN), is depicted in Figure 2.[9]

[9] There are two typos in Figure 2. First, "CAT5" should be "CATV." Amit describes the signals as propagating "in the CATV wires" and does not mention "CAT5" when describing Figure 2. *See* DISH-1014, 6:59-60. Further, Figure 1 of Amit's provisional application, U.S. Provisional Appl. No. 60/128,810, which corresponds to Amit's Figure 2, identifies the solid lines as "CATV" wires. DISH-1015, STAMP-9. Second, Amit defines HCNM as "[a] component that include[s]

DISH-1014, FIG. 2. Like the '518 patent, Amit's HomeCN incorporates network devices—shown below in orange—into the CATV infrastructure to enable networking over coaxial cables. *See id.*, 3:10-12; *see* DISH-1001, 4:35-47, Fig. 2, 8:1-3; DISH-1004, ¶152.



AMIT FIG. 2 (Annotated)

Amit's network devices include Home Cable Networking Units (HCNUs).

HCN-U and cable modem." DISH-1014, 6:15. Thus, instead of "HCNI + CABLE MODEM," box 206 should read "HCNU + CABLE MODEM." DISH-1004, ¶153.

DISH-1014, 6:7-16. The HCNU is "a component that suppl[ies] connection to the Home Cable Networking. This component is a separate unit that contains one or more interfaces to the home equipment (e.g. 10BaseT, USB, wireless). This component does bridging or routing between the HCN to the other interfaces (networks) [207,212]." DISH-1014, 6:7-13. Further, "[t]he HCNU devices are capable of transmitting and receiving digital communications signals between them. These signals propagate in the CATV wires and are reflected by the RF splitter [203]." *Id.*, 6:57-60. Specifically, the HCNU devices "communicate directly … using RF signaling over the coax cable." *Id.*, 3:19-21; DISH-1004, ¶154.

Amit's network devices also include a Home Cable Networking Modem (HCNM), which is "[a] component that include[s] [an] HCN-U and [a] cable modem." DISH-1014, 6:3-23. Amit also refers to the HCNUs and the HCNMs as HCN devices. *See id.*, claim 13; DISH-1004, ¶¶155-156.

2. Overview of Jacobsen

Jacobsen is a paper that was publicly available no later than 1995-09-19 and qualifies as prior art at least under §102(b). DISH-1016, Cover; DISH-1006, ¶9; DISH-1004, ¶157.

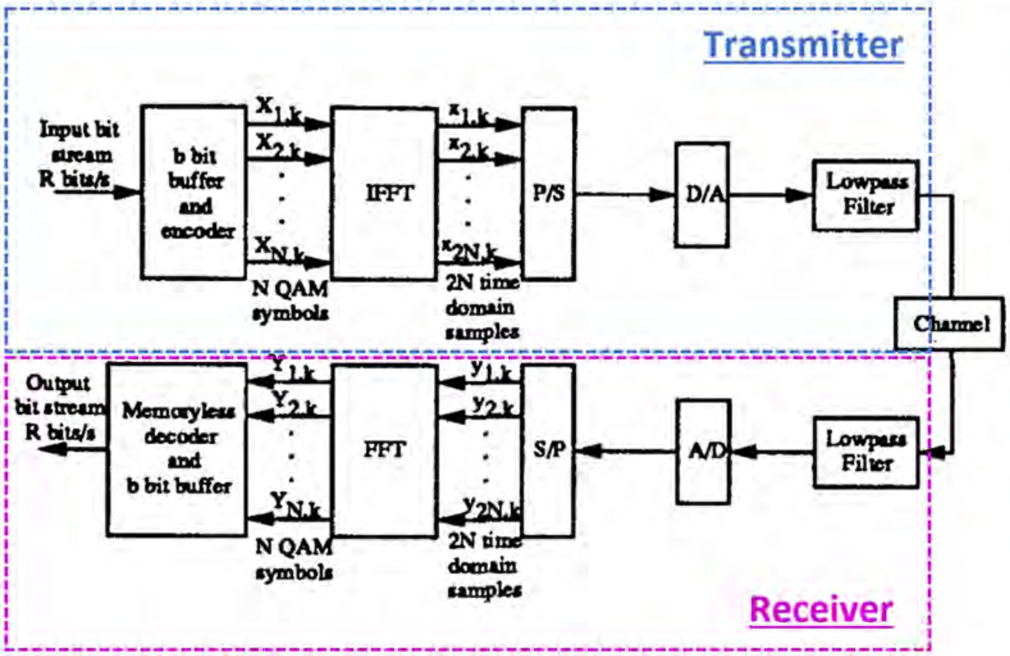
Jacobsen explores "[t]he feasibility of offering high-speed interactive data services … on CATV networks or similar broadband coaxial networks" and

recognizes that "there are several electrical transmission problems that must be overcome before these services can be supplied reliably over CATV networks." DISH-1016, 305. For example, "the hardware in CATV networks is not ideal" as the "[t]aps, amplifiers, and splitters can all cause signals to be reflected at their insertion points." *Id.* Jacobsen further recognizes that "[v]ariations in a channel's frequency response cause successively transmitted symbols to interfere with one another, an effect known as intersymbol interference (ISI)." *Id.* And "[w]ithout some scheme to combat ISI, a receiver would make detection errors." *Id.*; DISH-1004, ¶158.

To address these problems, Jacobsen "discuss[es] two candidate techniques for multimedia transmission on the CATV network: single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation." DISH-1016, 306. Jacobsen finds that multicarrier modulation "is more computationally efficient than single-carrier modulation … for the transmission of digital data over CATV channels" (*id.*, 312) and "is able to reduce the effects of various distortions on a CATV network" (*id.*, 305). Thus, like the '518 patent, Jacobsen proposes using multi-carrier modulation for the transmission of digital data over a CATV network. *Id.*, *see* DISH-1001, 7:22-27. Like the '518 patent, Jacobsen uses "[d]iscrete multitone modulation (DMT), a common form of multicarrier modulation." DISH-1016, 306; *see* DISH-1001, 7:22-27; DISH-1004,

¶¶159-160.

Jacobsen's Figure 1 illustrates a DMT transmitter (blue) and receiver (purple). DISH-1016, 307; DISH-1004, ¶¶161-162.



JACOBSEN FIGURE 1 (Annotated)

3. Combination of Amit, Jacobsen, and Isaksson

As explained below, the Amit-Jacobsen combination would improve Amit's coaxial HomeCN by incorporating Jacobsen's multi-carrier signaling on coaxial cables into Amit's HCN devices. DISH-1004, ¶163. Jacobsen's multi-carrier modulation is more computationally efficient for signaling over coaxial networks than Amit's single-carrier modulation, and it reduces the effects of distortions, such as reflections, on such networks. *Id.*

A POSITA would have also combined Amit-Jacobsen's HCN devices with Isaksson's synchronized bit-loading. *Id.*, ¶164. Isaksson's techniques would have helped avoid the multi-carrier signaling between HCN devices failing, for example, due to a transmitting device sending more or fewer bits per carrier than a receiving device expects. *Id.*

(a) Motivation

Starting with the Amit-Jacobsen combination, a POSITA seeking to implement Amit's coaxial network would have understood that although "coax cable is an excellent communication medium" (DISH-1014, 2:51-53), there can be "houses where there is a problem with reflection" (*id.*, 20:42-43). Amit identifies "[t]he 'hidden nodes' problem" and "[h]igh reflection" as "some RF challenges in designing the HomeCN components." *Id.*, 13:54-14:1. Moreover, Amit suggests that the varying "channel conditions" on coaxial networks necessitate different

communication techniques. *Id.*, 8:30-32; DISH-1004, ¶165.

Jacobsen similarly observes that in coaxial networks "[t]aps, amplifiers, and splitters can all cause signals to be **reflected** at their insertion points," and resulting "**[v]ariations in a channel's frequency response** cause successively transmitted symbols to interfere with one another, an effect known as intersymbol interference (ISI)." DISH-1016, 305; DISH-1004, ¶166.

Jacobsen discloses techniques to overcome these potential signal impairments on coaxial cables. *See* DISH-1016, 305-306. Jacobsen "discuss[es] two candidate techniques for multimedia transmission on the CATV network: single-carrier quadrature amplitude modulation (QAM) … and multicarrier modulation." *Id.*, 306. Jacobsen finds that multi-carrier modulation "is able to reduce the effects of various distortions on a CATV network, including microreflections and interference" (*id.*) and "easily adapt[s] to a variety of channel degradations" (*id.*, 312). Additionally, Jacobsen establishes that multi-carrier modulation "is more computationally efficient than single-carrier modulation … for the transmission of digital data over CATV channels." *Id.* Jacobsen concludes that "multicarrier modulation appears to be better equipped than single-carrier modulation" for digital communications on a coaxial network. *Id.*; DISH-1004, ¶167.

A POSITA implementing Amit's coaxial network would have been

motivated to address Amit's "RF challenges" using techniques from analogous coaxial networking publications that discuss broadband coaxial networks, including Jacobsen. DISH-1004, ¶¶168-169. Specifically, a POSITA would have been motivated to improve Amit's HomeCN using Jacobsen's teachings of multi-carrier modulation. *Id.* Amit expresses a desire to avoid signal impairments in coaxial networks and Jacobsen teaches techniques for overcoming such impairments using multi-carrier modulation. DISH-1014, 3:19-23, 20:42-43; DISH-1016, 305. A POSITA would have been motivated to combine Amit and Jacobsen's teachings because they both develop coaxial networks for digital communications and discuss overcoming signal impairments to achieve that goal. *See* §IV.B.1 and §IV.B.2, *supra*; DISH-1004, ¶¶168-170. Both references also recognize that providing high-speed data services on existing wiring infrastructure is a motivator for implementing broadband coaxial networks. *Id.*

Amit discusses modulation by stating that "[v]arious types of modulation can be used" by HCN devices (DISH-1014, 25:1-2), including "QPSK, QAM 16, QAM 64 or QAM 256" (*id.*, 8:30-33). As explained by Dr. Williams, a POSITA would have understood that Amit's modulation schemes are single-carrier schemes. DISH-1004, ¶¶171-172 (citing to DISH-1021 and DISH-1023 that identify QAM and QPSK, respectively, as single-carrier).

In view of Jacobsen's findings that multi-carrier modulation provides

advantages over single-carrier for digital communications over coaxial networks, a POSITA would have been further motivated to replace the single-carrier modulation in Amit's HomeCN with Jacobsen's multi-carrier signaling to overcome potential signal impairments in the HomeCN. *See* DISH-1016, 312; DISH-1004, ¶173.

Jacobsen describes how to implement multi-carrier modulation. Jacobsen explains that "a channel is divided into N equal-bandwidth subchannels" where "[e]ach subchannel … supports its own QAM constellation." DISH-1016, 306-07. The number of bits per subchannel is "assigned … in direct proportion to the subchannel signal-to-noise ratios." *Id.*, 307. "[T]he bit distribution," *i.e.*, bit-loading, "is continuously updated during transmission as the receiver sends the required information to the transmitter." *Id.* Thus, Amit's HCN devices implement multi-carrier modulation with bit-loading. DISH-1004, ¶175.

In the Amit-Jacobsen combination, Amit's HCN devices use multi-carrier signaling to communicate on coaxial cables. *Id.*, ¶176. By doing so, Amit's HCN devices overcome the potential signal impairments that occur on the coaxial cables. *Id.* In the signaling between Amit's HCN devices, "subchannels that suffer from little attenuation and/or little noise carry the most bits, while subchannels that are severely attenuated … might not carry any bits." DISH-1016, 307. This "alleviate[s] the problems caused by both frequency-domain ripple and

interferers." *Id.* Further, "because the bit distribution is continuously updated during transmission," Amit's HCN devices can tolerate "even severe and unpredictable interference." *Id.*; DISH-1004, ¶176.

Like Jacobsen, Isaksson teaches that in multi-carrier modulation "the available bandwidth is divided into a plurality of sub-channels." DISH-1013, 1:19-26. Also like Jacobsen, Isaksson recognizes that multi-carrier systems use bit-loading based on channel characteristics. *Id.*, 3:24-34 ("the number of transmitted bits per symbol is adapted, or regulated, to the signal-to-noise ratio (SNR) of the current carrier."); DISH-1004, ¶177.

Isaksson notes that bit-loading "dynamically affects, in time, the total bandwidth of the system." DISH-1013, 3:24-34. "This variation in bandwidth leads to an absolute system requirement for synchronous configuration of the transmitter and the receiver, in terms of the number of coded/decoded bits per symbol and carrier wave. If this requirement is not met, the system will be unable to maintain a connection." *Id.* Isaksson discloses a solution for "maintaining synchronism between two transceivers during dynamic system reconfiguration of bit-loading factors" to maintain a connection between the transceivers. *Id.*, 4:21-25. As described above, Isaksson's solution involves transceivers sending and measuring base sync frames (i.e., "channel probes") to determine channel characteristics for configuring bit-loading. *See* §IV.A.2, *supra*; DISH-1004, ¶178.

A POSITA would have been motivated to improve the Amit-Jacobsen HomeCN with Isaksson's synchronized bit-loading. DISH-1004, ¶179. As discussed, a POSITA would have been motivated to improve Amit's HCN devices by extending Amit's single-carrier modulation to Jacobsen's multi-carrier modulation. In view of Jacobsen's discussion of synchronizing bit distribution (DISH-1016, 307), a POSITA would have been further motivated to implement Isaksson's multi-carrier techniques to maintain connections between Amit's HCN devices using synchronized bit-loading. DISH-1004, ¶179. Isaksson's improvements synchronize the bit-loading parameters between Amit-Jacobsen's HCN devices such that the devices are aware of the bit-loading parameters assigned to the carriers in the channels between them. This would prevent the connections between Amit's HCN devices from failing due to one HCN device sending more/fewer bits per carrier than another HCN device expects. *Id.*

In the Amit-Jacobsen-Isaksson combination, Amit-Jacobsen's HCN devices would determine each carrier's channel characteristics to select the bit-loading. Each HCN device—as a transmitter—would transmit base sync frames having predetermined content to the other HCN devices over respective channels. The other HCN devices—as receivers—would analyze the received frames to determine the respective channels' characteristics. The transmitter HCN device would obtain information about the channel characteristics, *e.g.*, SNR, from the

receiver HCN devices and select the bit-loading parameters for the respective channels based on the received information. DISH-1004, ¶180.

A POSITA reading Amit's and Jacobsen's teachings about coaxial networks would have been motivated to improve such networks with methods used in related wired networks, such as Isaksson's network. *Id.*, ¶181. The three references demonstrate the relatedness between coaxial and non-coaxial wired networks. *Id.* For example, Amit explains the relatedness of its network and VDSL by explaining that, unlike prior networking solutions, its HomeCN does not interfere with VDSL. DISH-1014, 28:67. Indeed, Amit describes using the HomeCN to connect to non-cable infrastructures, e.g., "access network (xDSL)." *Id.*, 2:24-30. And as discussed, Isaksson recognizes that its features can extend to coaxial networks. *See* DISH-1013, 1:8-18, 3:4-15. Thus, a POSITA implementing coaxial multi-carrier networks according to Amit and Jacobsen would have been motivated to improve such networks with Isaksson's methods used in related wired networks. DISH-1004, ¶181.

A POSITA would have considered the Amit-Jacobsen-Isaksson combination to be an example of: (1) use of known techniques (Isaksson's synchronized bit-loading) to improve similar devices (Amit-Jacobsen's HCN devices) in the same way (overcoming interference and maintaining connections with other HCN devices); (2) a teaching, suggestion, or motivation in Isaksson that would have led

a POSITA to implement the Amit-Jacobsen combination with Isaksson's synchronized bit-loading; and (3) combining prior art elements (Isaksson's synchronized bit-loading) according to known methods to yield predictable results (Amit-Jacobsen's HCN devices using multi-carrier signaling with synchronized bit-loading). DISH-1004, ¶182; *see KSR*, 550 U.S. at 415-21.

Like Isaksson, Amit and Jacobsen are analogous art to the '518 patent because they are from the same field of endeavor as the patent—wired networking systems—and are reasonably pertinent to the particular problem at issue in the patent—overcoming wired network signal impairment issues. DISH-1004, ¶¶183-184.

(b) Reasonable Expectation of Success

A POSITA would have had a reasonable expectation that the Amit-Jacobsen combination would produce a successful outcome. DISH-1004, ¶185. When contemplating Amit's HomeCN, a POSITA would have been familiar with references, like Jacobsen, describing coaxial networks for delivering high-speed data and the methods of implementing such networks. *Id.* Due to the similarity in the coaxial networks, a POSITA would have had a reasonable expectation that the combination would produce a successful outcome. *Id.*

Single-carrier and multi-carrier modulation were well known in the art at least by the year 2000. DISH-1004, ¶¶187, 192-197 (citing to DISH-1017, DISH-1018,

and DISH-1022). A POSITA would have understood the relationship between single-carrier and multi-carrier modulation, namely that multi-carrier builds upon single-carrier modulation by expanding the modulation from one carrier to many carriers. *Id.* Given Amit's disclosure of using single-carrier modulation (DISH-1014, 8:30-33, 25:1-10), Jacobsen's proposal of multi-carrier modulation to accommodate noisy environments and interferers would have been straightforward to a POSITA. DISH-1004, ¶186.

Moreover, a POSITA would have had a reasonable expectation that the Amit-Jacobsen-Isaksson combination would produce a successful outcome. DISH-1004, ¶188. Multi-carrier modulation is already taught in the Amit-Jacobsen combination, and therefore, applying Isaksson's multi-carrier teachings would have been using known techniques to improve similar devices in the same way. *Id.*; *KSR*, 550 U.S. at 415-21. Indeed, Isaksson states, "[i]t should be emphasised [sic] that the present invention can be used not only with the [described] system … but with other multi-carrier systems." DISH-1013, 72:5-8; DISH-1004, ¶188.

A POSITA would have expected Isaksson's multi-carrier improvements to work in the Amit-Jacobsen network because the network already employed multi-carrier modulation with features like Isaksson's. *Id.*, ¶¶189-190. Like Isaksson's system in which the "bit-loading factors are calculated in an initial training" (DISH-1013, 54), Jacobsen describes that "bits are originally assigned to

subchannels just after training" (DISH-1016, 307). And like Isaksson's system in which "the number of transmitted bits … is adapted … to the signal-to-noise ratio (SNR) of the current carrier" (DISH-1013, Abstract), in Jacobsen "bits are originally assigned to subchannels … in direct proportion to the sub-channel signal-to-noise ratios" (DISH-1016, 307). DISH-1004, ¶¶189-190.

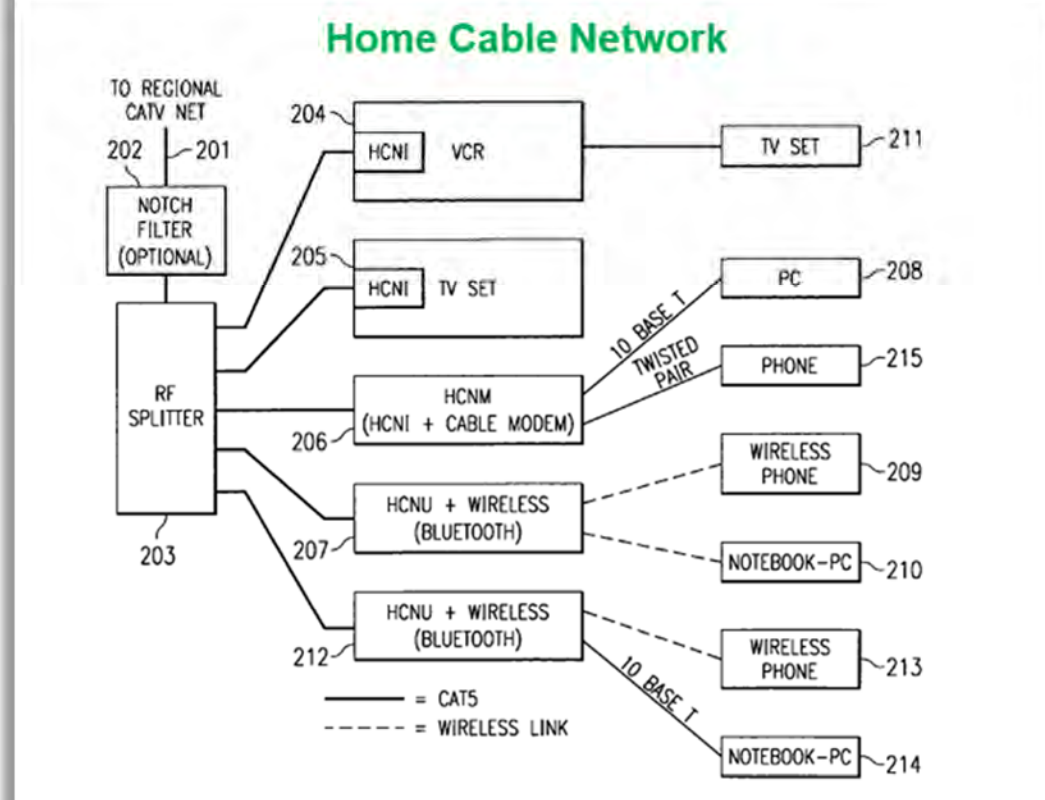
Using Isaksson's improvements therefore amounts to a straightforward adaptation that permits dynamic adjustments to bit-loading to maintain synchronism between devices on the network. DISH-1013, 3:24-34; DISH-1004, ¶191. Implementing Isaksson's improvements would have been within the skill level of a POSITA because, as explained, multi-carrier modulation is used in many applications and taught in courses that a POSITA would have taken. *Id.*

4. Claim 1

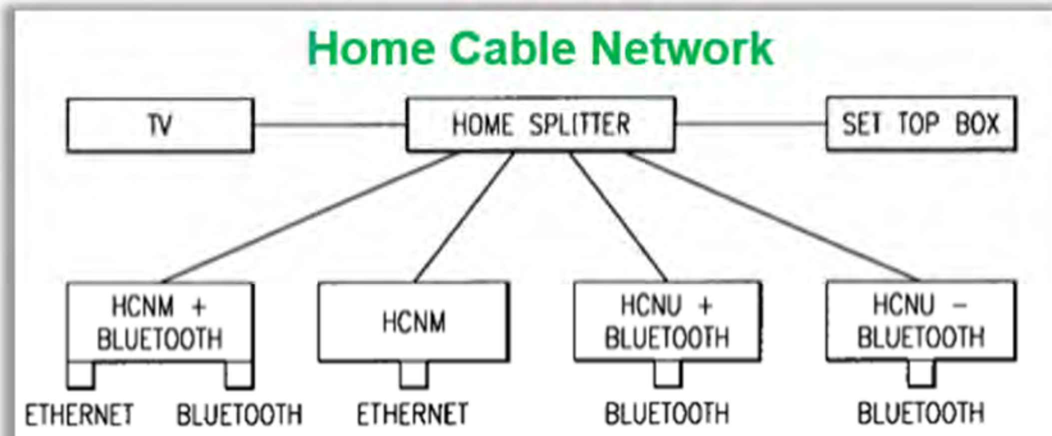
[1pre]

To the extent the preamble is limiting, Amit discloses [1pre]. Amit "relates to **communications systems**, and more particularly, to systems and methods for **home network communications**." DISH-1014, 1:10-12. Amit's Home Cable Network (HomeCN or HCN) "allow[s] very high-speed **digital and analog communications within the home** and from the home to external devices or networks using low cost devices." *Id.*, 2:40-43. The HomeCN, *i.e.*, the claimed "data communication network," is shown in green in Amit's Figures 2 and 13

below. DISH-1004, ¶¶198-200. Amit teaches that its HCN devices "**communicate directly** (not via the headend) using RF signaling over the coax cable." *Id.*, 3:19-21; *see id.*, 3:10-13, 6:58-60; DISH-1004, ¶¶198-200.



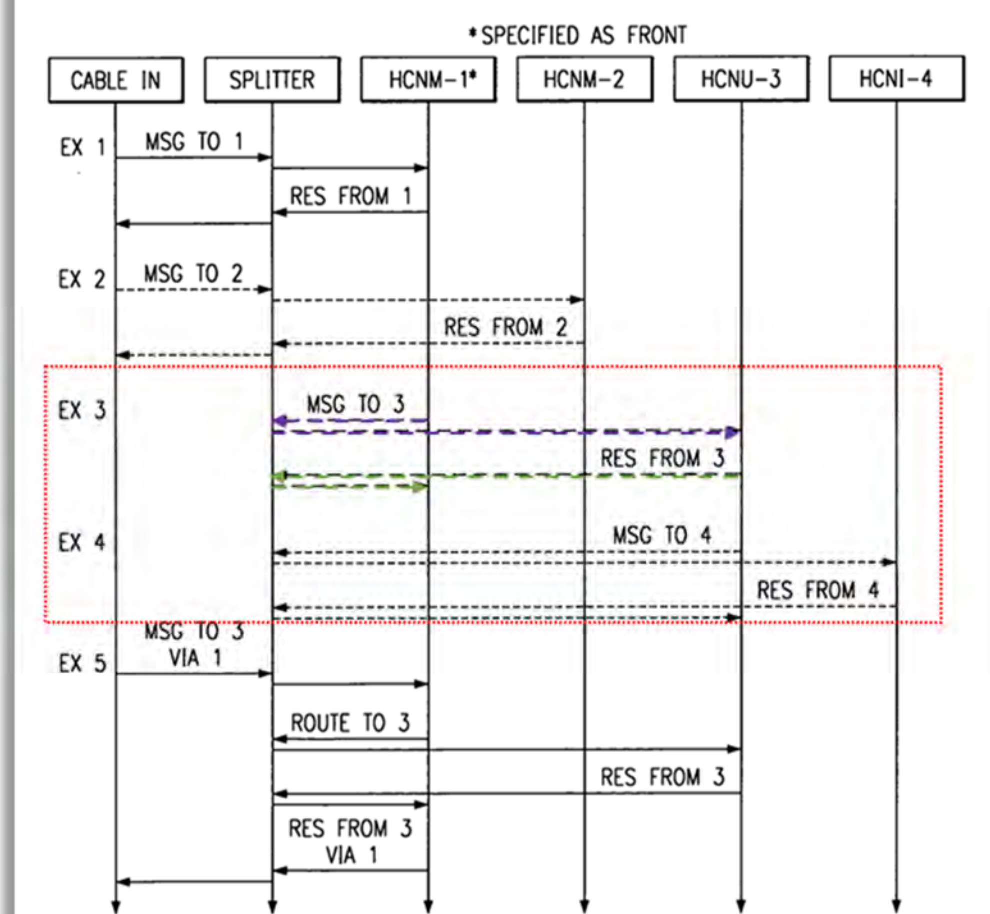
AMIT FIG. 2 (Annotated)



AMIT FIG. 13 (Annotated)

Figure 9 presents examples of data communications that occur in the

HomeCN. DISH-1014, 16:9-10. Ex 3 and Ex 4 (red) are example data communications between devices in the HomeCN. *Id.*, 16:15-21; DISH-1004, ¶¶201-203.



AMIT FIG. 9 (Annotated)

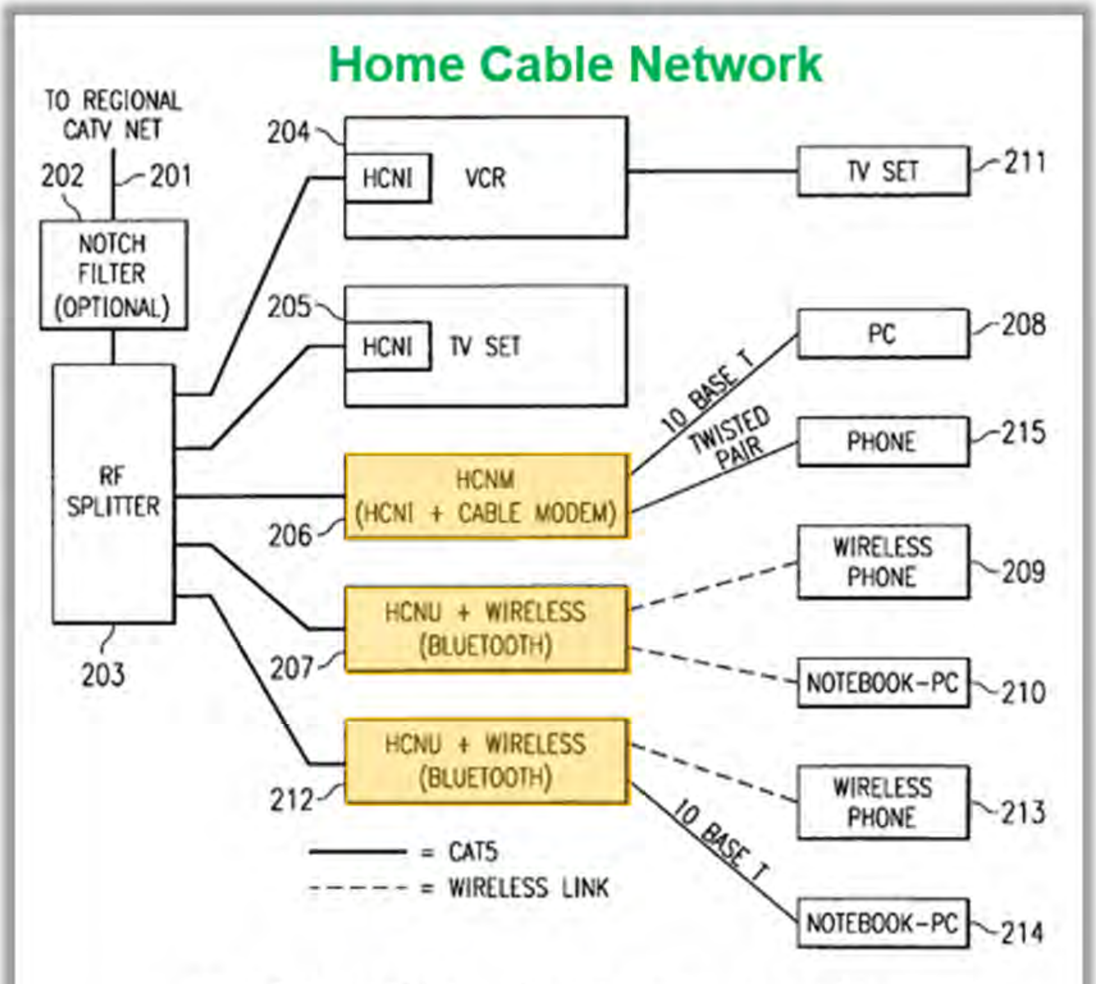
[1a.i]

Amit's HomeCN includes at least two HCN devices, *i.e.*, the claimed "at least two network devices," to enable networking over coaxial cables. *See* DISH-1014, 3:10-12. The HCN devices include Home Cable Networking Units

(HCNUs) and/or Home Cable Networking Modems (HCNMs). DISH-1014, 6:7-16; DISH-1004, ¶¶204-205.

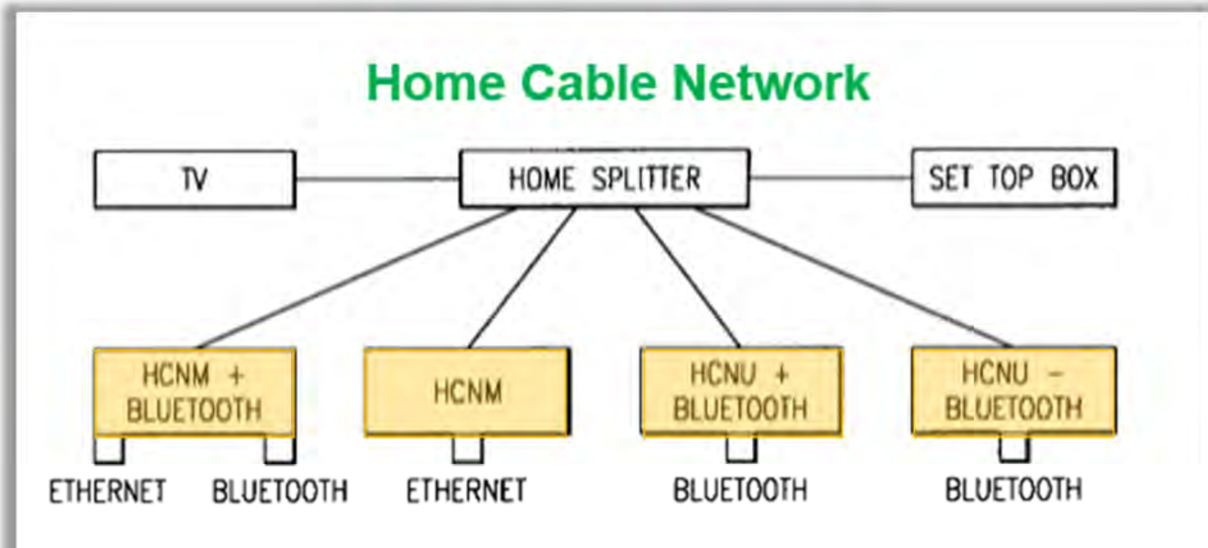
Amit's HCNU is "a component that suppl[ies] connection to the Home Cable Networking." DISH-1014, 6:7-13. "The HCNU devices are capable of transmitting and receiving digital communications signals between them. These signals propagate in the CATV wires and are reflected by the RF splitter [203]." *Id.*, 6:57-60. And the HCNM is "[a] component that include[s] [an] HCN-U and cable modem." DISH-1014, 6:3-23; DISH-1004, ¶206.

In Figure 2, Amit "shows a Home Cable networking (HomeCN/HCN)," in green below, that includes two HCNUs and an HCNM, *i.e.*, "***at least two network devices***," shown in orange. *Id.*, 6:26-29; DISH-1004, ¶¶207-208.



AMIT FIG. 2 (Annotated)

Figure 13 shows another configuration of the HomeCN that includes at least two network devices, namely two HCNMs and two HCNUs. DISH-1014, FIG. 13; DISH-1004, ¶209-210.



AMIT FIG. 13 (Annotated)

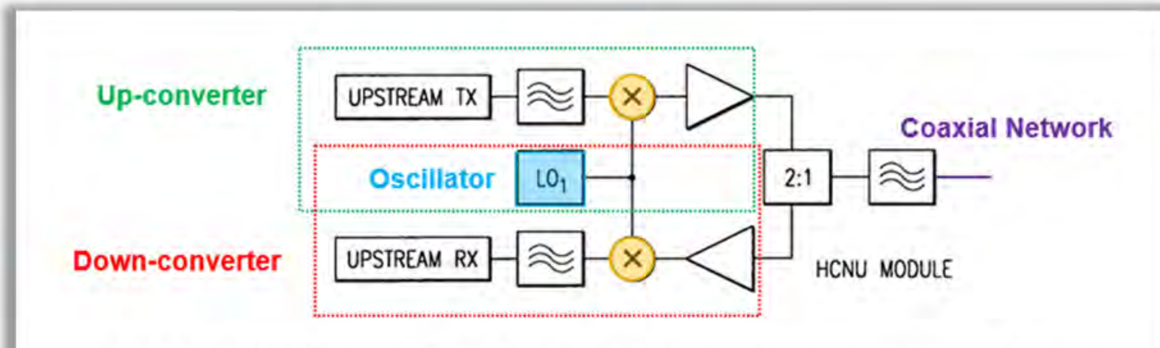
[1a.ii]

As discussed, Amit discloses that the HomeCN is a data communication network in which the HCN devices, including HCNUs and HCNMs, communicate with each other, *e.g.*, to deliver data from one device to another. *See elements* 1pre-1a.i, *supra*.

Claimed "up converter" and "down converter": Amit further discloses that the HCN devices communicate using RF signaling over the coaxial cables of the HomeCN. DISH-1014, 3:19-21 ("devices may communicate directly (not via the headend) using RF signaling over the coax cable"). The frequency range of the RF signaling, *i.e.*, ***the RF carrier frequency***, can be 900–960 MHz. *Id.*, 3:24-27, 8:21-29 ("Frequency range … usually 900–960 MHz"). Each HCN device includes

transmitter (TX)/receiver (RX) circuitry that enables the device to communicate using RF signaling. *Id.*, 29:19-21 ("[T]he components [that] should exist on the chip: Burst receiver, Burst Transmitter, 900 MHz front end (bi-directional)"), FIG. 18 (showing the HCNM including a 900 MHz TX+RX front end for the home networking channel), FIG. 19 (showing the HCNU including a 900 MHz TX+RX front end for the home networking channel); DISH-1004, ¶¶211-215, 221.

Amit's HCN device circuitry includes frequency converters, which Amit depicts in Figure 11. DISH-1014, FIG. 11. A POSITA would have understood that, based on Amit's disclosures and the general knowledge in the art, the figure depicts frequency conversion circuitry. *See id.*, 3:24-30, 11:61-65, 19:32-37; DISH-1004, ¶216. A POSITA would have understood that the depicted frequency conversion circuitry includes an up-converter and a down-converter, shown below in the relevant portion of Figure 11 in green and red, respectively. *Id.* Both the up-converter and the down-converter use a local oscillator (LO) block—shown in blue—that drives multipliers—shown in orange—that up/down-convert to/from an RF carrier frequency used on the coaxial network (shown in purple). *Id.*



AMIT FIG. 11 (Excerpted and Annotated)

To transmit a signal, Amit's upstream TX block obtains data that originates upstream from a node (e.g., a PC) connected to the HCN device. *Id.*, ¶217. The upstream TX signal is up-converted by the multiplier/LO blocks, amplified, and transmitted on the coaxial network (*i.e.*, the claimed "translating … data to an RF carrier frequency"). *Id.* To receive a signal, Amit's multiplier/LO blocks down-convert an RF signal received over the coaxial network (*i.e.*, the claimed "translating an RF signal"), which the upstream RX block then routes to the node. *Id.* Indeed, Amit describes another device that includes frequency conversion circuitry as having the ability to "translate[] the input frequency to another, whether if it is with an up and down conversion or other technique such as conversion to baseband and back." DISH-1014, 20:32-35; DISH-1004, ¶217.

The conversion circuitry shown in Amit's Figure 11 is well known in the art such that a POSITA would have understood that the circuitry is frequency conversion circuitry. DISH-1004, ¶218. This circuitry is taught in introductory

textbooks in communications engineering. *Id.* For example, Gagliardi (published in 1988) describes conversion circuitry similar to that of Figure 11. *Id.*

Gagliardi first explains that "[f]requency conversion (translating [a signal] at one frequency to a band at another frequency) requires additional carrier waveforms, produced from subsystems referred to as frequency generators." DISH-1017, 93. An oscillator can be used as a frequency generator. *Id.* ("Carrier tones are generated from oscillator circuits"); *see also id.*, 99 ("an oscillator carrier can be frequency multiplied to form a frequency generator"); DISH-1004, ¶219.

Gagliardi then provides an up-converter as an example frequency converter. DISH-1017, 99-100. Gagliardi explains that "frequency shifting to a higher frequency band (called upconversion) is accomplished by a mixer circuit." *Id.* "An ideal mixer (Figure 3.6a) corresponds to an electronic multiplier followed by a bandpass filter." *Id.*; DISH-1004, ¶220. Like in Amit's Figure 11, the inputs into the multiplier include the data signal and the carrier mixing signal provided by the frequency generator. *Id.*

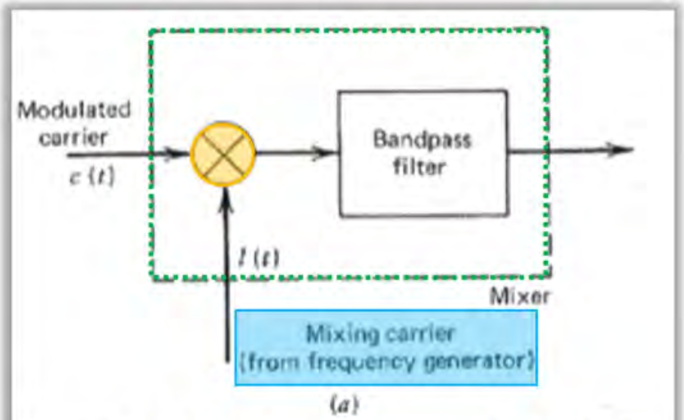
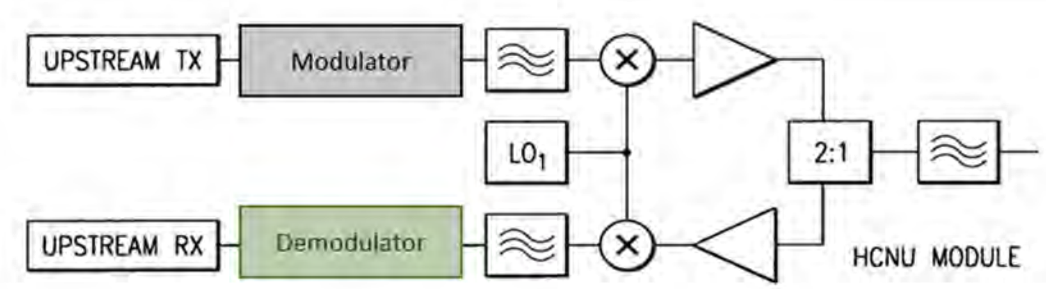


Figure 3.6. Mixer block diagrams: (a) multiplier,

Claimed "modulator" and "demodulator": Amit discloses that the HomeCN "employs a new digital modulation scheme." DISH-1014, 3:7-8. In particular, each HCN device includes a modulator that employs "QPSK, QAM 16, QAM 64 or QAM 256 according to the channel conditions, and according to the equipment capabilities." *Id.*, 8:30-37. Because Amit's HCN devices are transceivers that send and receive signals, a POSITA would have understood that each HCN device also includes a demodulator in the receiver circuitry. *See id.*, FIGS. 18-19 (showing TX/RX circuitry of HCN devices), 3:19-20 ("devices may communicate directly (not via the headend) using RF signaling"), *see also* claim 13 (reciting that an HCN includes circuitry for modulating and demodulating signals); DISH-1004, ¶222. Thus, Amit discloses or alone renders obvious the claimed "demodulator for demodulating the translated RF signal to produce data."

A POSITA would have understood that Amit's modulator modulates the upstream TX data to be transmitted on the coaxial network. DISH-1004, ¶223-

227. A POSITA would have understood that the modulator provides the modulated data to the up-converter to be up-converted to the RF carrier frequency for transmission on the coaxial network. *Id.* Further, a POSITA would have understood that the down-converter performs an inverse of the up-converter operations and the demodulator performs an inverse of the modulator operations. *Id.*; DISH-1001, 9:22-27 (disclosing inverse operations of modulators were "well known in the art"). The (de)modulator+frequency conversion circuitry architecture, as would have been understood by a POSITA, is illustrated in the modified and annotated Figure 11 below.



AMIT FIG. 11 (Modified and Annotated)

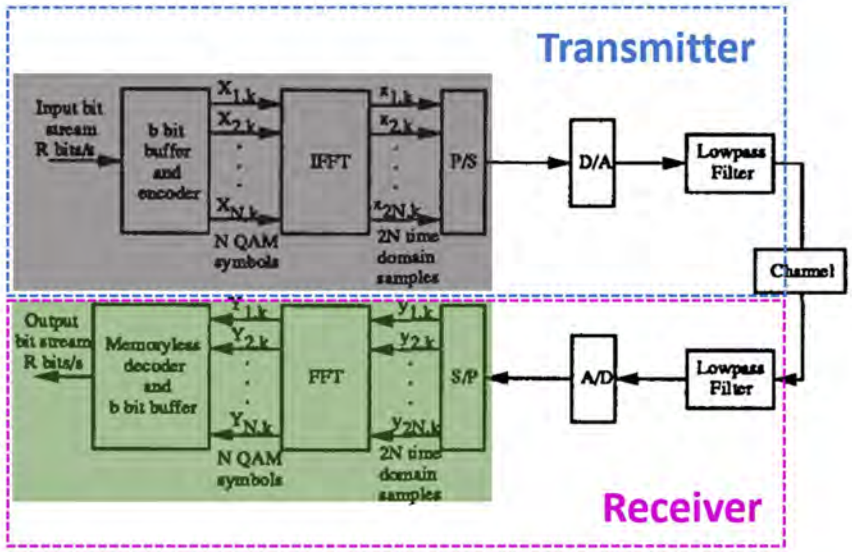
As explained by Dr. Williams, similar architectures are disclosed in Mason, which the '518 patent described as disclosing "techniques for implementing an OFDM modulator and demodulator." DISH-1001, 4:8-12; DISH-1004, ¶228-229 (citing to DISH-1020).

Thus, for each network device, Amit discloses the claimed "modulator for

modulating data" and "demodulator for demodulating the translated RF signal to produce data." DISH-1004, ¶232. As explained by Dr. Williams, using the described transmitter and receiver architectures in cable modems that operate on coaxial networks was known to a POSITA. *See id.*, ¶¶230-231 (citing to DISH-1019).

Claimed "multi-carrier" elements: Jacobsen analyzes and "discuss[es] two candidate techniques for multimedia transmission on the CATV network: single-carrier quadrature amplitude modulation (QAM) with equalization and multicarrier modulation." DISH-1016, 306. Jacobsen assesses multi-carrier modulation using "[d]iscrete multitone modulation (DMT), a common form of multicarrier modulation." *Id.*, DISH-1004, ¶233.

Jacobsen's Figure 1 shows a block diagram of a DMT transmitter and receiver. DISH-1016, 307. The transmitter includes a multi-carrier modulator for modulating signals to be transmitted on the coaxial cable channel. DISH-1004, ¶234. And the receiver includes a multi-carrier demodulator for demodulating the modulated signals received on the coaxial cable channel. *Id.*



JACOBSEN FIGURE 1 (Annotated)

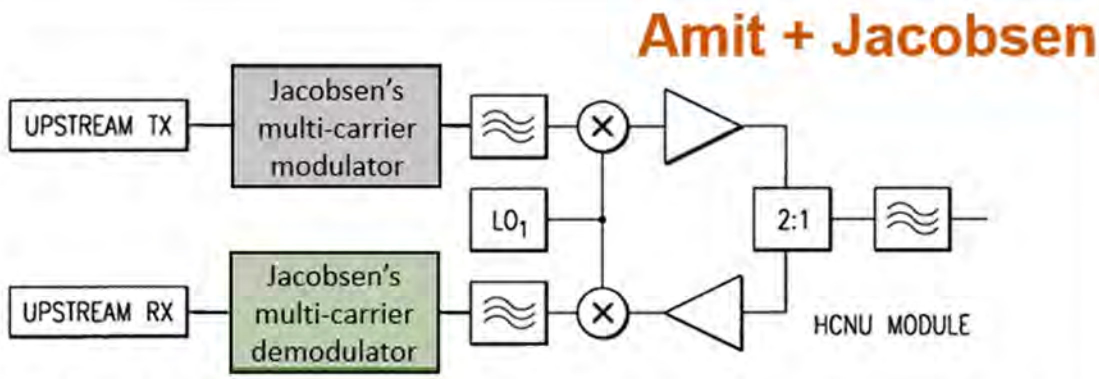
Jacobsen explains that "multitone modulation is more computationally efficient than single-carrier modulation … for the transmission of digital data over CATV channels" and "is able to reduce the effects of various distortions on a CATV network, including microreflections." DISH-1016, 305, 312. Jacobsen thus concludes that "multicarrier modulation appears to be better equipped than single-carrier modulation" for a consumer service digital transmission system. *Id.*, 312; DISH-1004, ¶235.

In view of Jacobsen's findings, a POSITA would have found it obvious to implement multi-carrier modulation in Amit's system. To do so, a POSITA would have ensured that Amit's modulator was a multi-carrier modulator like Jacobsen's, and that Amit's demodulator was a multi-carrier demodulator like Jacobsen's.

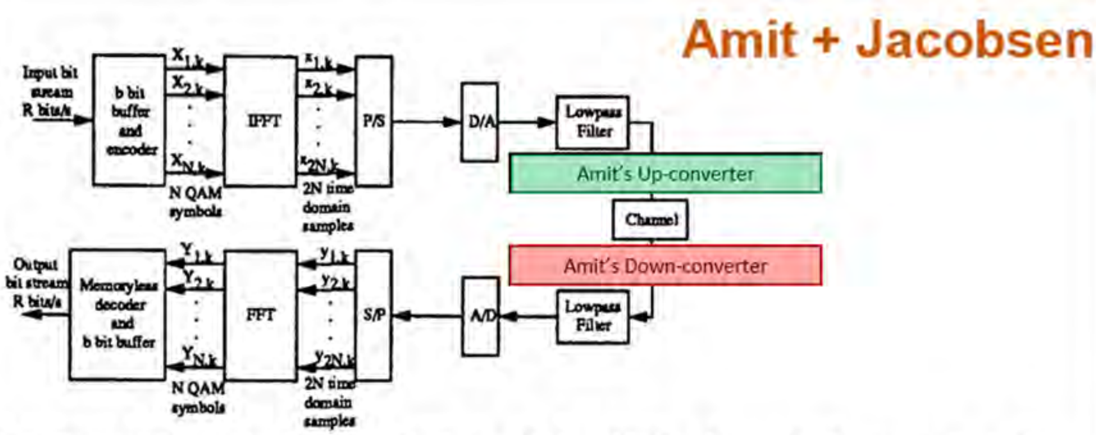
DISH-1004, ¶236.

Specifically, as shown below, Jacobsen's modulator would have been used in Amit's up-converter, e.g., by connecting the output of Jacobsen's low pass filter in the modulator to Amit's up-converter. *Id.*, ¶237. The combined circuitry modulates an input bit-stream, which is then up-converted by the up-converter to generate a multi-carrier RF signal for transmission on the coaxial network. *Id.*

Similarly, Jacobsen's demodulator would have been used in Amit's down-converter, e.g., by connecting the input of Jacobsen's low pass filter in the demodulator to the output of Amit's down-converter. *Id.*, ¶238. The combined circuitry down-converts the multi-carrier RF signal received from the coaxial network, which is then demodulated by the demodulator circuitry to produce the output bit-stream. *Id.*

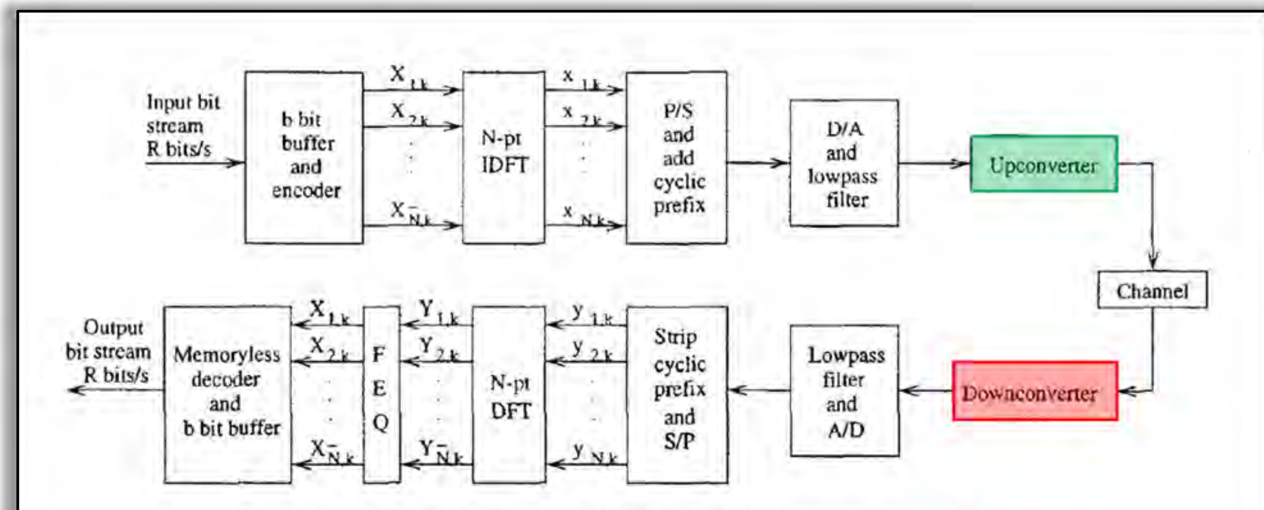


AMIT FIG. 11 (Modified and Annotated)



JACOBSEN FIGURE 1 (Modified and Annotated)

That a POSITA would have combined Jacobsen's DMT with Amit's conversion circuitry as described is confirmed by another reference, Jacobsen2, that Jacobsen authored, which illustrates a DMT coupled to conversion circuitry. DISH-1023, 376; DISH-1004, ¶¶239-240.

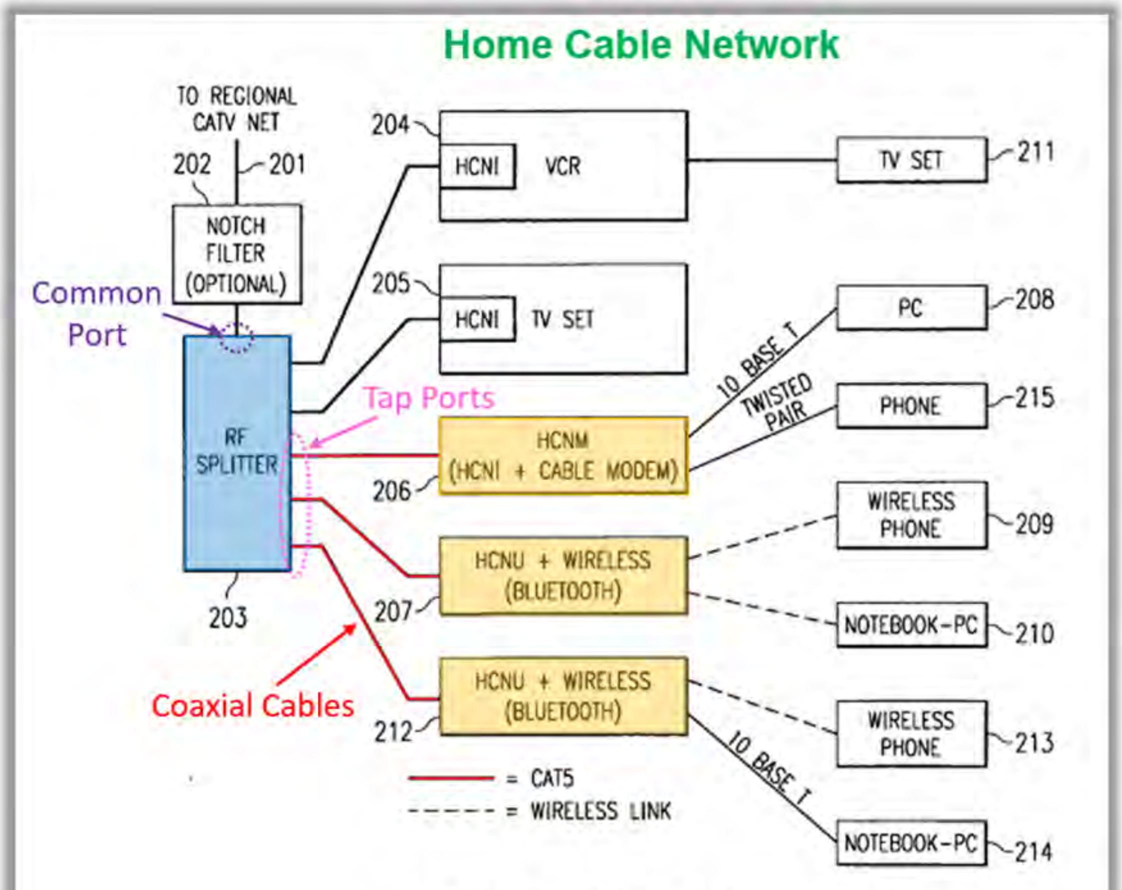


JACOBSEN2 FIGURE 2 (Annotated)

[1b]

Amit discloses that an application of the HomeCN is "home networking over coaxial TV cables." DISH-1014, 2:38-40. Amit teaches its HCN devices "communicate directly (not via the headend) using RF signaling over the coax cable." *Id.*, 3:19-21. The RF signals "propagate between the devices via reflections from other devices in the line, e.g. splitters or amplifiers in the line." *Id.*, 3:21-23; DISH-1004, ¶¶241-242.

In Amit's Figure 2, "RF splitter [203] splits the signal coming from and to the regional CATV plant [201], to the signals coming to and from units [204–207, 212] respectively." DISH-1014, 2:36-39; DISH-1004, ¶243.



AMIT FIG. 2 (Annotated)

As shown above, the RF splitter [203] has a common port (purple) and a plurality of tap ports (pink). *Id.*, ¶¶244-245. Segments of coaxial cable (red) connect between the splitter tap ports and the HCN devices (orange). *Id.* Amit explains how, in its coaxial cable network, "[s]plitters [] get a single wire as [an] input, and some wires as output[s]." DISH-1014, 8:66-67; DISH-1004, ¶¶244-245.

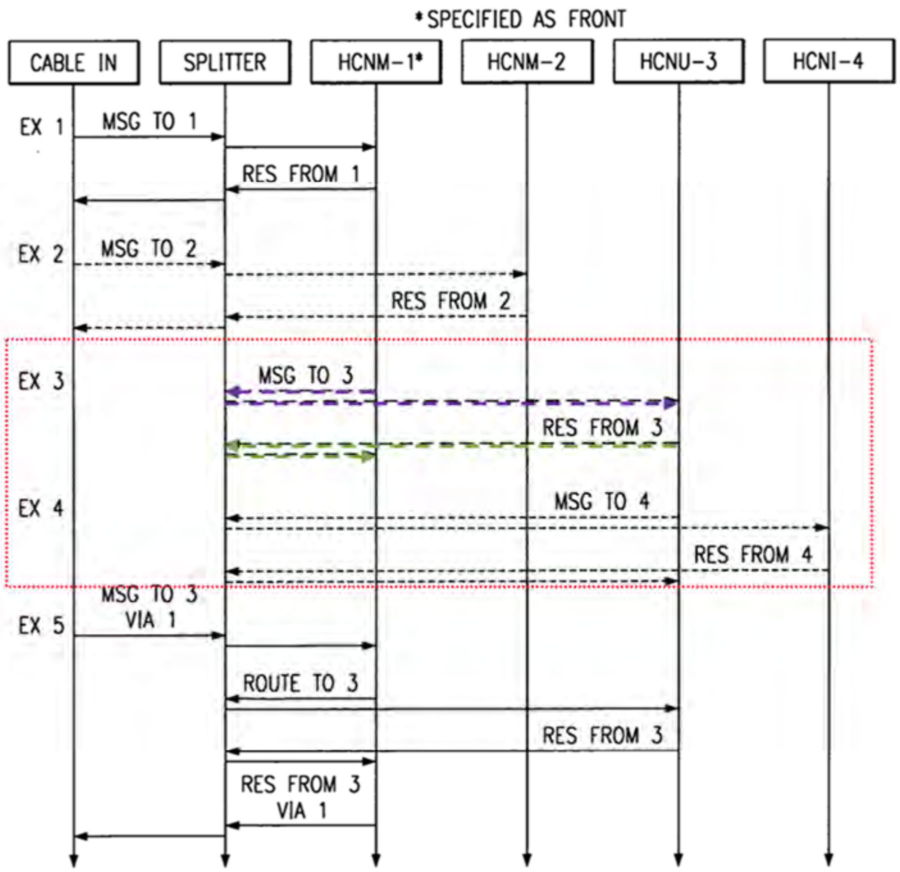
[1c]

As discussed, the Amit-Jacobsen HCN devices each include a multi-carrier modulator for generating multi-carrier RF signals and multi-carrier demodulators

for processing received multi-carrier RF signals. *See* element 1a.ii, *supra*.

Additionally, Amit discloses that HCN devices communicate with each other over cable infrastructure, including coaxial cables—*i.e.*, the claimed "network devices communicate with each other through the cable wiring." Specifically, the "installation of modems, connected to different types of nodes of the CATV… enable[s] communication between these nodes" (DISH-1014, 3:10-13, 6:57-59), where the "communication … [occurs] over cable infrastructure designed to carry video signals, using pass-band frequency bands, without transmission through a CATV headend device." *Id.*, 2:34-38. That is, the HCN devices "communicate directly (not via the headend) using RF signaling over the coax cable." *Id.*, 3:19-21; DISH-1004, ¶¶246-248.

To do so, "messages from the home equipment is [sic] transferred to the splitter, the splitter distributes the energy … to the other output connectors that are connected to the splitter." DISH-1014, 16:18-21. Then, the "destination-component gets the message and returns the response." *Id.* For example, in Ex 3 and Ex 4 of Figure 9 (red), HCNM-1 sends a data message (purple, MSG TO 3) to HCNU-3, after which HCNU-3 sends a response message (green, RES FROM 3) to HCNM-1. *Id.*, 16:9-17; DISH-1004, ¶249.



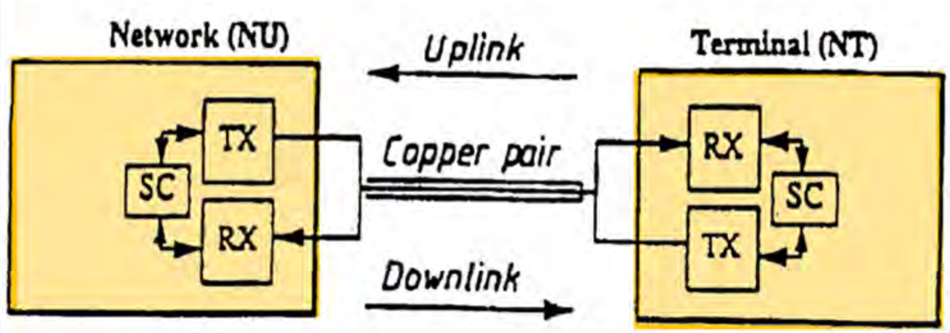
AMIT FIG. 9 (Annotated)

Because the Amit-Jacobsen HCN devices are using multi-carrier modulation, the communication between the devices through the cable wiring of HomeCN is multi-carrier signaling (*i.e.*, the claimed "network devices communicate with each other through the cable wiring using multi-carrier signaling"). DISH-1004, ¶¶250-251.

[1d.i]

As discussed, Amit's HCN devices communicate using multi-carrier signaling. *See* element 1c, *supra*.

Isaksson similarly describes "a multi-carrier transmission system" that includes two multi-carrier transceivers/modems (*i.e.*, "network devices"), shown below in orange, that communicate using multi-carrier signaling. DISH-1013, Fig. 22, 1:1-18. As shown below, each transceiver has a receiver and a transmitter. *Id.*; DISH-1004, ¶¶252-254.



ISAKSSON FIG. 22 (Annotated)

In Isaksson's multi-carrier transmission system, the receivers (in both transceivers) "continuously measure[] and estimate[] the characteristics and changes of/in the channel." DISH-1013, 4:1-8. The "[c]hannel characteristics may be estimated by periodic transmission, by one of said transceivers, of a base sync frame having a predetermined content and comparing, in the other of said

transceivers, the received sync frame with a reference frame." *Id.*, 16:8-12; *see also id.*, 10:10-14. By having a transmitter (in one transceiver) transmit a base sync frame with predetermined content, which a receiver (in another transceiver) can compare with a reference frame, the receiver "can estimate the characteristics of the channel, over which the frame is transmitted, in terms of attenuation, phase shift and variance." *Id.*, 79:5-14. A POSITA would have understood that to estimate a channel's characteristics, the receiver would compare a signal of the received frame to the reference frame to determine the attenuation, phase shift, and variance the signal experienced over the channel. DISH-1004, ¶255.

Isaksson describes that the transceivers periodically transmit the base sync frames at a base sync interval. DISH-1013, 16:15-20. "Additional sync frames may be transmitted at intervals between said base sync frames." *Id.* Therefore, Isaksson's transceivers transmit and receive multiple base sync frames to one another through the cable wiring. DISH-1004, ¶256.

As discussed, although Isaksson does not refer to the "base sync frame" as a "probe message," a POSITA would have understood Isaksson's base sync frame to be a "probe message" because Isaksson's definition of "base sync frame" is effectively identical to the '518 patent's definition of "probe message." *See* §IV.A.4, *supra*; DISH-1004, ¶257.

As also discussed, a POSITA would have found it obvious to modify the

combined Amit-Jacobsen HCN devices with Isaksson's synchronized bit-loading. DISH-1013, 4:21-25; DISH-1004, ¶258.

Here, each of Amit-Jacobsen's HCN devices—as an uplink HCN device—would periodically transmit base sync frames, *i.e.*, probe messages, having predetermined content to other HCN devices—as downlink HCN devices—through coaxial cables (*i.e.*, the claimed "network devices transmit probe messages through the cable wiring"). DISH-1013, 16:8-12. The downlink HCN devices would analyze the received frames by comparing them with reference frames to determine channel characteristics. *Id.*, 79:9-14. In particular, the downlink HCN devices would analyze the signals of the received frames to characterize the channel in terms of attenuation, phase shift, and variance, *i.e.*, the claimed "analyze received probe message signals to determine channel characteristics." *Id.*, 16:15-20. The receiver in the uplink HCN device also analyzes received frames from the downlink HCN devices. *See id.*, 77:21-79:4; DISH-1004, ¶¶259-260.

[1d.ii]

Isaksson also discloses that bit-loading parameters are selected based on the determined channel characteristics. DISH-1004, ¶261-263.

In Isaksson's system, "[d]ata is transmitted between the two transceivers using a plurality of carriers." DISH-1013, 25:26-26:20. Isaksson teaches its transceivers can "dynamically chang[e] the number of coded/decoded bits per

carrier." *Id.*, 4:1-20. To do so, each receiver continuously measures the channel characteristics. *Id.* "From this information, performance for each sub-channel (sub-wave) is identified." Then, based on the information, "reconfigurations of the transmitted number of bits per symbol for each single carrier wave are decided." *Id.*; DISH-1004, ¶264.

Specifically, Isaksson's receivers send information about the measured channels to the Isaksson's transmitter in the uplink transceiver. *See* DISH-1013, 77:27-79:14 (the transmitter "obtains information about measured channels from the uplink and downlink receivers."). Then, Isaksson's transmitter selects "the bit-loading for each carrier" and "transmits the bit-loading constellation … to the downlink transceiver." *Id.* The transmitter also changes the bit-loading constellation in the uplink transceiver. *See id.*; DISH-1004, ¶265.

Isaksson discloses that the information based of which Isaksson's system selects bit-loading is SNR. *See* DISH-1013, 3:24-27. The "individual carrier's SNR is calculated on the receiver side." *Id.*, 26:12-14. Then "the number of transmitted bits per symbol is adapted, or regulated, to the signal-to-noise ratio (SNR) of the current carrier." *Id.*, 3:24-27. As explained by Dr. Williams, a POSITA would have understood that "attenuation, phase shift and variance," which are measured by the receivers, can be used by the receivers to calculate SNR. DISH-1004, ¶266.

As discussed in the previous limitation, each of Amit-Jacobsen's HCN devices—as an uplink HCN device—would periodically transmit base sync frames to other HCN devices—as downlink HCN devices. DISH-1013, 16:8-12. Amit-Jacobsen's downlink HCN devices would analyze the received frames to determine channel characteristics. Then, Amit-Jacobsen's downlink HCN devices would send information about the channel characteristics, e.g., SNR, to the uplink HCN device. *See id.*, 77:27-79:14. The uplink HCN device would select the bit-loading parameters for the channels based on the received information of the determined channel characteristics, *i.e.*, the claimed "bit loading is selected based on the determined channel characteristics." *Id.*, 4:1-20. DISH-1004, ¶¶267-269.

5. Claim 3

[3a]

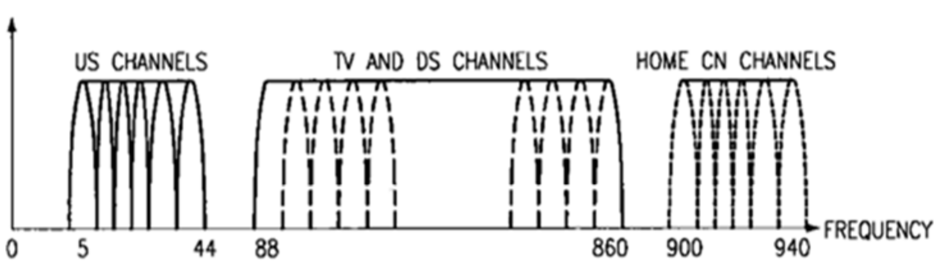
Amit discloses that "[t]he home networking equipment coexists with the other services on the cable network … [such that] [i]t is spectrally aligned with any combination of television and other signals in the cables; and [i]t does not cause harmful interference to any other services that are assigned to the cable network." DISH-1014, 18:46-56; DISH-1004, ¶¶270-272.

[3b]

As discussed in [1a.ii], Amit discloses an up-converter that translates the modulated data to an RF carrier frequency. *See* element 1a.ii, *supra*.

Amit also discloses that the carrier frequency used by the HomeCN is above

the frequency used by the cable television service. DISH-1014, 3:24-27 ("When the home coaxial cables are connected to a local or regional CATV network, the HomeCN is done in an out-of-band frequency (i.e. band that is not in use, e.g. above 860 MHz)."). Amit's Figure 5 depicts a "typical channel allocation" in a system that supplies "TV channels, DOCSIS CM (US and DS), and HomeCN channels." *Id.*, FIG. 5, 7:61-63. As shown below, the frequency band used by the cable television service is below 860 MHz. *Id.* As also shown, the frequency band dedicated to the HomeCN channels, *i.e.*, the RF carrier frequency, is 900-940 MHz, *i.e.*, "above the frequency used by the cable television service." *Id.*, 7:61-8:3, 8:22-28; DISH-1004, ¶¶273-277.



AMIT FIG. 5

V. DISCRETION SHOULD NOT PRECLUDE INSTITUTION

A. The *Fintiv* Factors Favor Institution—§314(a)

Institution is consistent with the Director's guidance on applying the *Fintiv* Factors. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20,

2020) (precedential) ("*Fintiv*"); *Memorandum: Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation* (June 21, 2022) ("*Director's Guidance*"). A holistic analysis of the *Fintiv* framework favors institution. *Fintiv*, 6.

1. Factor 1: Institution Supports Stays in Parallel Proceedings

Should the Board institute this proceeding, DISH will move to stay the District Court case, which the Court will likely grant. *CAO Lighting, Inc. v. Signify N. Am. Corp.*, No. CV 21-08972-AB (SP), 2022 WL 20563918, at *2 (C.D. Cal. Dec. 21, 2022) (recognizing "near uniform line of authority reflecting the principal that after the PTAB has instituted review proceedings, the parallel district court litigation ordinarily should be stayed"). Institution of this proceeding makes a stay of the companion litigation likely, *e.g.*, because this proceeding's resolution would simplify the issues before the Court by enabling the Board to resolve most of the validity issues concerning the '518 patent, removing any duplicative efforts that would be required by the Court with respect to "any ground that the petitioner raised or reasonably could have raised" during this IPR. 35 U.S.C. § 315(e)(2); *C.R. Laurence Co., Inc. v. Frameless Hardware Company, LLC et al.*, 2:21-cv-01334-JWH-RAO (CDCA, December 9, 2022); *Guy A. Shaked Investments, Ltd. et al. v. Trade Box, LLC,* 2:19-cv-10593-AB-MAA (CDCA, November 18, 2020); *Masimo Corporation et al. v. Apple Inc., 8:20-cv-00048-JVS-JDE* (CDCA,

October 13, 2020); (all granting motions to stay pending IPRs).

2. Factor 2: The Board's Final Written Decision Will Likely Issue in Advance of Any Foreseeable Trial

The District Court case was filed on February 10, 2023 but due to multiple motions to dismiss, DISH filed its Answer to the Complaint on September 21, 2023. The trial date has not been set. Over all civil cases, the median time to trial in CDCA was 28.4 months in the most recent reporting period. DISH-1026. However, the median time to trial for CDCA patent cases in 2023 is **34.4 months**. DISH-1029. The anticipated July 2025 Final Written Decision ("FWD") would likely issue well in advance of the median time-estimated trial date of December 2025 (based on 34 months).

Moreover, the Court set the Claim Construction Hearing for September 17, 2024. DISH-1027. It is highly unlikely that the case would be ready for trial by an anticipated FWD date in July 2025, given that a number of burdensome tasks must be completed in the nine months following the hearing, *e.g.*, fact discovery, expert discovery, dispositive motions, etc. What's more, the aforementioned high likelihood that a stay will be granted pushes an estimated trial date back even further. Regardless, given the filing of this petition before any trial schedule has been set, the District Court may adjust its schedule to ensure a trial date after the estimated date for the FWD.

In sum, the uncertainty of a trial date, and the strong likelihood that the

estimated date of issuance of the FWD would come before any such trial date, weigh in favor of institution. And, even if it did not, "the proximity to trial should not alone outweigh" other relevant factors. *Director's Guidance*, 8.

3. Factor 3: Petitioner's Diligence Outweighs the Parties' Investment in the Litigation

The District Court proceeding is in its early stages, and the parties' and Court's investment has been minimal. Indeed, as discussed above, the Court has not, *e.g.*, resolved whether venue is proper or issued a full schedule that would set a date for trial. Moreover, claim construction briefing is not set to begin until July 2024. DISH-1027.

Patent Owner asserted twelve patents in its complaint. Ten remain after resolution of DISH's motion to dismiss. Further, Patent Owner just recently served infringement contentions (September 29, 2023), which disclosed the full list of asserted claims for the first time.[10] Despite the large volume of and recent notice of asserted claims, DISH diligently worked to prepare multiple petitions and is filing them significantly earlier than the one-year statutory bar date.

DISH's substantial investment in its IPR petitions outweighs the minimal resources invested in the co-pending litigation. The minimal resources expended

[10] Patent Owner's complaint identified just a single claim for each of the multiple asserted patents.

in the District Court have been borne equally by both parties, unlike the significant resources expended by DISH to prepare its petitions—effort that would be irretrievably lost without consideration of these petitions on the merits, in addition to the extensive expenses DISH will accrue in the remaining portion of the co-pending litigation.

In sum, this Petition was diligently filed well before the one-year statutory bar date and with minimal investment in the district court litigation. *Mylan*, IPR2018-01680, Paper 22 at 18 (finding that petition filed two months before bar date is "well within the timeframe allowed by statute, weighing heavily in [petitioner's] favor"). Petitioner's diligence in filing this Petition shortly after receiving Patent Owner's initial infringement contentions and at an early stage of the companion litigation weighs in favor of institution. *See, e.g., Apple Inc. v. Seven Networks LLC*, IPR2020-00156, Paper 10 at 11-12 (PTAB Jun. 15, 2020) (finding factor 3 in Petitioner's favor where "Petitioner did not wait until the eve of the statutory bar date to file the Petition"); *Sotera Wireless, Inc. v. Masimo Corp.*, Paper 12 at 16-17 (PTAB Dec. 1, 2020) (comparing investment in district court case with IPR petitions to find factor 3 in Petitioner's favor).

4. Factor 4: The Petition Raises Unique Issues

DISH asks the Board to consider the unique challenges raised in the Petition. *See Fintiv*, 12-13. Only claim 1 is asserted in district court, but this Petition

challenges both claims 1 and 3. The challenge to claim 3 is a unique issue for the Board to consider. If the Board institutes the pending Petition, DISH will not pursue district court invalidity challenges based on the same grounds in this petition pursuant to 35 U.S.C. §315(e), thereby eliminating any risk of duplicated effort between the District Court proceeding and the IPR.

5. Factor 5: DISH's Involvement in Parallel Proceedings

The parties are the same in this IPR and in the parallel District Court proceeding.

6. Factor 6: The Merits Support Institution

As *Fintiv* noted, "the factors … are part of a balanced assessment of all the relevant circumstances in the case," and, "if the merits of a ground raised in the petition seem particularly strong … the institution of a trial may serve the interest of overall system efficiency and integrity…." *Fintiv*, 14-15. As explained in the Petition (with expert testimony from Dr. Williams), the grounds raised herein are strong, and institution would result in invalidation of the Challenged Claims.

B. Citing a Quasi-Related Reference in the Specification Does Not Warrant Discretionary Denial Under §325(d)

The Examiner never issued a rejection over prior art during the '518 patent's prosecution and this Petition's prior art references and arguments were not considered or cited in the prosecution of the '518 patent. *See generally* DISH-1002.

US6438174 ('174 patent), which shares a priority date, inventorship, and some description with Isaksson, was cited in the '518 patent's specification. DISH-1001, 8:19-23. Isaksson, however, is from a different patent family than the '174 patent and includes subject matter—relied upon in this Petition—not found in the '174 patent. Further, there is no evidence that substantive consideration was given to the '174 patent or Isaksson by the Examiner or whether the Examiner noted and considered the '174 patent's reference in the specification. *See Scientific Design Co. v. Shell Oil Co.*, IPR2021-01537, Paper7 at 24-26 (PTAB 2022) and IPR2022-00158, Paper 7 at 24-26 (PTAB 2022) (granting institution despite Examiner initialing the asserted art on IDS); *Fox Factory, Inc. v. SRAM, LLC*, IPR2016-01876, Paper8 at 7-9 (PTAB 2017) (refusing to deny institution where reference cited but not considered at length).

Thus, this Petition does not involve the same or substantially the same prior art or arguments previously presented to the Office. *Advanced Bionics* strongly favors institution. *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 (PTAB Feb. 13, 2020) (precedential).

VI. CONCLUSION

Petitioner respectfully requests institution of an IPR and cancellation of all Challenged Claims.

VII. PAYMENT OF FEES – 37 C.F.R. §42.103

Please apply any fees to Deposit Account No. 06-1050.

VIII. MANDATORY NOTICES UNDER 37 C.F.R §42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. §42.8(b)(1)

DISH Network L.L.C. is petitioner and real party-in-interest. Dish Network Service L.L.C., DISH Network Corporation, and Dish Network California Service Corporation are additional real parties-in-interest. No other party had access to or control over the filing of this Petition, and Petitioner did not file this Petition for the benefit of any other party or entity.

B. Related Matters Under 37 C.F.R. §42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates, or petitions for *Inter Partes* Review of the '518 patent.

Petitioner is aware of the following civil actions involving the subject matter of the '518 patent.

Case Number	Filing Date
Entropic Communications, LLC v. DirecTV, LLC f/k/a DirecTV, Inc. et al., 2-23-cv-05253 (CDCA)	July 1, 2023
Entropic Communications, LLC v. DISH Network Corporation et al., 2-23-cv-01043 (CDCA)	February 10, 2023
Entropic Communications, LLC v. Cox Communications, Inc. et al., 2-23-cv-01047 (CDCA)	February 10, 2023
Entropic Communications, LLC v. Comcast Corporation et al., 2-23-cv-01048 (CDCA)	February 10, 2023
Entropic Communications, LLC v. Charter Communications, Inc., 2-23-cv-00050 (EDTX)	February 10, 2023
Entropic Communications, Inc. v. ViXS Systems, Inc. et al., 3-13-cv-01102 (SDCA)	May 8, 2023

C. Lead And Back-Up Counsel Under 37 C.F.R. §42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup counsel
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D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR45035-0025IP1@fr.com.

Respectfully submitted,

Dated: January 16, 2024

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(Control No. IPR2024-00393)

Attorney for Petitioner

CERTIFICATION UNDER 37 CFR §42.24

Under the provisions of 37 CFR §42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,826 words, which is less than the 14,000 allowed under 37 CFR §42.24.

Dated: January 16, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on January 16, 2024, a complete and entire copy of this Petition for *Inter partes* Review, Power of Attorney, and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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